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(54) **MEDICAL DEVICE FOR CAUSING THE HEMOSTASIS OF A BLOOD VESSEL**

(57) A medical device for causing the hemostasis of a blood vessel for use through an endoscope, said medical device comprising a handle (1), a sheath device (2), which is attached to the handle (1), a clamp device (3) including a clamp base (6) in particular in the form of a sleeve provided on the distal end of the sheath device (2) and at least or exactly two clamp arms, a control wire (4) extending through the sheath device (2) and reversibly movable in the distal and proximal directions and an actuator (5) coupled to the proximal end of the control wire (4) and actuable to reversibly move the control wire (4) in the distal and proximal directions.

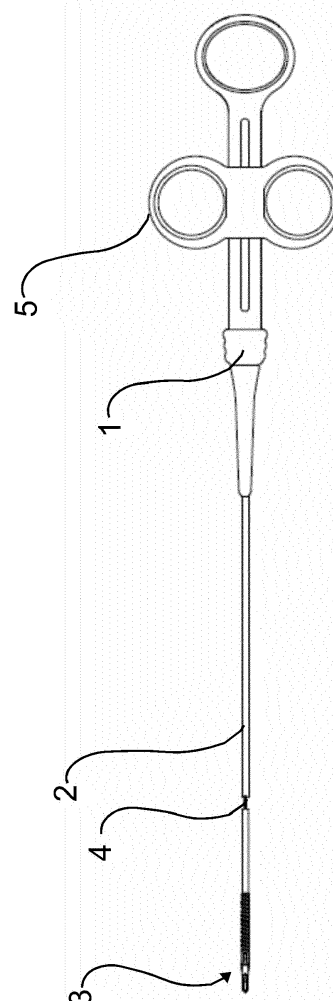


Fig. 1

Description

[0001] The present invention relates to a medical device for causing the hemostasis of a blood vessel for use through an endoscope, said medical device comprising:

a handle;

a sheath device, which is attached to the handle;

a clamp device including a clamp base in particular in the form of a sleeve provided on the distal end of the sheath device and at least two or exactly two clamp arms;

a control wire extending through the sheath device and reversibly movable in the distal and proximal directions;

an actuator coupled to the proximal end of the control wire and operable to reversibly move the control wire in the distal and proximal directions; and

wherein the clamp arms are each coupled to the distal end of the control wire and wherein the clamp device is operable to open and close the clamp arms by a movement of the control wire such that a movement of the control wire in the proximal direction is translated into a closing movement of the clamp arms and the movement of the control wire in the distal direction is translated to an opening movement of the clamp arms.

[0002] Medical devices of this kind are known for example from EP 1 328 199 B1 and in particular used to treat gastrointestinal bleedings. Specifically such devices are used to set clamps or clips to pinch a bleeding vessel applying sufficient constrictive force to the blood vessel so as to limit or interrupt blood flow there through.

[0003] The medical device known from EP 1 328 199 B1 comprises a handle and a sheath, which is attached to the handle. A control wire extends through the sheath and can be actuated by an actuator, which is coupled to the proximal end of the control wire to reversibly move the control wire in the distal and proximal directions. The medical device further includes a clamp device including a sleeve provided on the distal end of the sheath and a clip with two clamp arms that are coupled to the distal end of the control wire by means of a J-hook. The clamp arms cooperate with the sleeve in such a way, that the clamp arms engage the front edge of the sleeve to be elastically deformed inwardly, thus being closed, when the control wire is pulled in the proximal direction, whereas the clamp arms are distally pushed out of the sleeve and automatically reopen due to their elastic restoring force, when the control wire is pushed in the distal direction. Since the clamp device can be repeatedly opened and closed, setting of the clamp device is possible in an easy way.

[0004] Once the clamp device is positioned correctly, the clamp device with the clamp arms and the sleeve can be disconnected from the rest of the medical device. In order to do so the control wire is further pulled back, when the clamp device is completely closed, so that the J-hooks break and thus the connection between the clamp arms and the control wire is interrupted. Moreover by further pulling back the control wire a retainer which connects the control wire with the sleeve is actuated, in order to disconnect the retainer and thus the control wire from the sleeve.

[0005] In view of this prior art it is the object of the invention to provide a medical device of the above mentioned kind that is easy to operate as well as easy to manufacture and assemble.

[0006] According to the present invention this object is solved by a medical device of the above mentioned kind, which is characterized in that the clamp arms are coupled to the control wire by means of a pivot pin which is provided at the distal end section of the control wire and extends through corresponding through-holes provided in the tail ends of the clamp arms, and that exit-passages are provided in the tail ends of the clamp arms at the proximal side of the through-holes, through which after closing the clamp arms the pivot pin can be pulled out of the through-holes and from the clamp arms spreading apart the tail end sections of the clamp arms on the opposite sides of the exit-passages without breaking them by a proximal movement of the control wire in order to uncouple the control wire from the clamp arms.

[0007] According to the present invention the clamp arms are directly coupled to the control wire, thus omitting the necessity to provide for a separate connecting element for example in the form of a J-hook. Specifically the control wire is provided at its distal end section with a pivot pin, which engages corresponding through-holes provided in the proximal end sections of the clamp arms.

[0008] The through-holes are open to the proximal end of the clamp arms. Specifically exit-passages are provided which are designed such, that they are small enough, so that the pivot pin cannot fall out of the clamp arms unintentionally, but can be intentionally pulled out of the through-holes through the exit-passages by exerting a sufficiently high tensile force to the control wire, so that the tail end sections of the clamp arms on the opposite side of the exit-passages are spread apart and thus deformed.

[0009] The exit-passages may for example be formed by slits in the tail ends of the clamp arms.

[0010] According to a further embodiment of the invention the tail end sections of the clamp arms are elastically or plastically deformed, when they are spread apart. In any way the arrangement is such that the tail end sections do not break in order to avoid, that parts of the breakable arms remain freely in the body of a patient.

[0011] A preferred embodiment of the present invention is characterized in that the tail end sections of the clamp arms on the opposite sides of the exit passages engage behind at least one shoulder of the clamp base in order to lock the clamp arms to the clamp base. Preferably the tail end sections of the clamp arms on the opposite sides of the exit-passages form hooks that engage behind the at least one shoulder of the clamp base in order to lock the clamp arms to the clamp base.

[0012] The shoulder can be formed by an annular projection of the clamp base, wherein the annular projection in particular forms the distal end face of the clamp base with a central opening, through which the tail end sections of the clamp arms extend into the clamp base when the clamp arms are fully closed.

[0013] If the tail end sections on the opposite side of the exit-passages of the clamp arms are plastically deformed, when the pivot pin is pulled out of engagement from the clamp arms provision is made, that their proximal ends are positioned behind, i.e. on the proximal side of the shoulder of the clamp base so that they are plastically deformed to engage behind the shoulder lock the clamp arms to the clamp base and consequently the clamp arms cannot be removed from the clamp base anymore. In this way further separate locking elements are not necessary.

[0014] According to a further embodiment of the present invention a coupling head is provided at the distal end of the control wire and the pivot pin is provided on the coupling head. The pivot pin may have two pivot pin sections extending from opposite side of the coupling head into the through-holes of the clamp arms which are positioned on opposite sides of the coupling head. This arrangement is useful, when the clamp arms are provided on different sides of the coupling head. Alternatively the coupling head may include a U-shaped holding structure opened to its distal side, wherein the clamp arms are partly arranged between the U-legs and the pivot pin is held between the U-legs and extends through the through-holes of the clamp arms, and wherein, in particular, the clamp arms extend laterally outwards of the open lateral side of the U-shaped holding structure. In this embodiment the clamp arms are arranged in the U-shaped holding structure and may therefore be in direct contact with each other.

[0015] According to a further aspect of the present invention the object is solved by a medical device of the initially mentioned kind, which is characterized in that the clamp device includes exactly two clamp arms which are provided as separate elements, that are each coupled to the distal end of the control wire in a pivotal manner around a common pivot axis defined by a pivot pin, wherein each clamp arm is provided with a guide groove and the guide grooves of the clamp arms partially overlap each other, and a guide pin which is attached to the clamp base and extends through the guide grooves in the overlapping parts thereof, so that by the engagement of the guide pin and the guide grooves a movement of the control wire in the proximal direction is translated into a closing movement of the clamp arms and a movement of the control wire in the distal direction is translated into an opening movement of the clamp arms around the pivot axis.

[0016] According to this embodiment the clamp arms are separate elements/components that are not directly connected to one another. Instead they are each coupled to the control wire by the engagement of their through-holes with the pivot pin. Moreover they are coupled by the engagement of the guide pin and the guide grooves to the clamp base in such a way, that an axial movement of the control wire is translated into closing/opening movements of the clamp arms around the pivot axis. According to a preferred embodiment the guide pin is held between two bearing arms, extending in the distal direction from the clamp base, in particular at the free end sections of the bearing arms. The clamp base and the bearing arms form a clamp housing.

[0017] A preferred embodiment is characterized in that holding noses are provided on the clamp arms, the holding noses extending into the guide grooves from a lateral sides thereof and being designed in such a way, that they allow the guide pins to pass them to reach the distal ends of the guide grooves but prevent passing of the guide pins in the opposite direction, wherein in particular the guide grooves have a straight, axially extending distal end section, in which the guide pins can move without incurring rotation of the clamp arms and the holding noses extend into the straight distal end sections. In particular recesses may be formed in the lateral sides of the guide grooves on the distal side of the holding nose, into which the holding noses are elastically deformed to allow the guide pins to pass the holding noses and reach their distal end positions in the guide grooves.

[0018] According to this embodiment the guide pin is captured in the distal ends of the guide grooves by means of the holding noses, thus locking the clamp to the clamp base. In this way further locking elements are no more necessary.

[0019] A further embodiment of the present invention can be formed such that the clamp base is reversibly and directly connected to the sheath device by at least one connecting element and that a release arrangement cooperating with each connecting element is provided and can be actuated by movement of the control wire in the proximal direction to release the clamp base from the sheath device, when the clamp arms have been closed, wherein each connecting element is fixedly attached to or part of the clamp base and releasably connected to the sheath device, or wherein each connecting element is fixedly attached to or part of the sheath device and releasably connected to the clamp base.

[0020] According to this embodiment the clamp base and the sheath device are directly connected to each other by

according connecting elements, which are fixedly provided on the one component and releasably connected to the other component. In this way a very reliable and stable connection between the clamp base and the sheath device is obtained, without necessitating any separate connecting elements. In this way the medical device according to the present invention is simple in design and easy to manufacture. The connecting elements can be actuated in order to release the clamp base from the sheath device, when the clamp arms have been closed. Specifically the arrangement is such that when the clamp arms have been closed and the control wire is moved further in the proximal direction the clamp base is released from the sheath device.

[0021] According to an embodiment of the present invention the sheath device comprises a sheath and a connect tube fixedly provided on the distal end of the sheath. For example the connect tube can be welded to the sheath. Further the sheath can be an extendable coiled sheath.

[0022] Preferable not a single, but several connecting elements are provided with a regular angular offset along the outer circumference of the clamp base. In particular two connecting elements are provided on opposite sides of the clamp base.

[0023] According to a further embodiment of the present invention each connecting element is fixedly attached to or part of the clamp base and releasably connected to the sheath device, in particular the connect tube of the sheath device, and has a free end formed as an engagement portion, which engages corresponding engagement means of the sheath device, in particular a recess and preferably a ring groove provided in the outer circumferential surface of the sheath device in order to releasably connect the clamp base to the sheath device. If the recess is formed as a ring groove the clamp base can be turned by 360° relative to the sheath device.

[0024] A further embodiment of the present invention provides, that the release arrangement comprises a protrusion provided on the control wire and arranged to come into engagement with each connecting element by a proximal movement of the control wire to release the clamp base from the sheath device, when the clamp arms have been closed, wherein the protrusion in particular is formed as part of a coupling head provided at the distal end of the control wire.

[0025] According to one alternative of this embodiment the connecting elements are elastically or plastically deformed by the engagement with the protrusion in order to bring the connecting portion of each connecting element out of engagement of the corresponding engagement means of the sheath device. In this case, preferably, each connecting element is provided in the form of a connecting arm, that has an inwardly bulged section, the protrusion engaging the inwardly bulged section in order to elastically or plastically deform the connecting arm outwardly.

[0026] In this embodiment the protrusion provided on the control wire engages the inwardly sections in order to elastically deform the connecting arms outwardly, so that their free ends, which engage the corresponding engagement means of the sheath device, are also deformed outwardly and come out of engagement of the engagement means.

[0027] According to an alternative embodiment each connecting element is plastically deformed by the engagement with the protrusion in order to bring its connecting portion out of engagement from the corresponding engagement means of the sheath device. Preferably each connecting element is formed as a C-shaped connecting element, wherein the central bar of the C-shaped connecting element is attached at a connection site to the clamp base, a distal C-leg extends inwardly into the clamp base, so that it can be engaged by the protrusion, and the other proximal C-leg forms the engagement portion and extends inwardly to engage the corresponding engagement means of the sheath device and wherein by the engagement of the protrusion with the distal C-leg the connecting element is pivoted around the connection site to move the proximal C-leg out of engagement from the sheath device.

[0028] Both embodiments allow a simple construction/design of the clamp base, thus keeping the manufacturing costs low.

[0029] When the connecting element is fixedly attached to the sheath device, in particular a connect tube of the sheath device, or part thereof and releasably connected to the clamp base, a further embodiment of the invention provides, that each connecting element is provided in the form of resilient, elastically deformable connecting arm, wherein the proximal end of the connecting element is attached to or part of the sheath device and the free distal end of the connecting element forms the engagement portion to be brought into engagement with corresponding engagement means of the clamp base, in particular a recess and preferably a ring groove provided in the outer circumferential surface of the clamp base, and wherein each connecting element has an inwardly bulged section and the release arrangement comprises a protrusion, in particular a cylindrical protrusion provided on the control wire and cooperating with the inwardly bulged sections in such a way, that the protrusion presses the inwardly bulged section outwardly in order to elastically deform the connecting elements, so that the engagement portions of the connecting elements are pressed inwardly into engagement with the corresponding engagement means of the clamp base when the protrusion is located between the inwardly bulged sections, and that when the control wire in the closed state of the clamp arms is moved further in the proximal direction the protrusion comes out of engagement from the inwardly bulged sections, so that the inwardly bulged sections are deformed inwardly by their elastic restoring force and the connecting portions come out of engagement of the corresponding engagement means of the clamp base.

[0030] In this embodiment the elastic connecting arms forming the connecting elements are actively held in engagement with the recess/groove provided in the clamp base by the engagement of the protrusion and the inwardly bulged sections

of the connecting arms. Once this engagement is no more existent, because the control wire is pulled back in the proximal direction so far, that the protrusion is no more between the bulged sections, the latter are elastically deformed inwardly by their restoring force. In other words the connection between the sheath device and the clamp base is passively released by moving the protrusion of the control wire out of the range of the bulged sections.

[0031] Preferably, on the distal side of the bulged portions a connecting element extends out of the connect tube through windows provided in the circumferential wall of the connect tube, and when the protrusion is located between the inwardly bulged portions so that the connecting elements are outwardly deformed, the connecting elements are pressed against abutment faces, in particular slanted abutment faces on the proximal side of the windows leading to an inward deformation of the distal ends of the connecting elements so that their connecting portions are pressed against the corresponding engagement means of the clamp base.

[0032] Embodiments of the invention will in the following be described making reference to the attached drawings. In these drawings

Figure 1 shows a front view of a medical device according to a first embodiment of the present invention,

Figure 2 shows in enlarged scale the front, distal part of the medical device of figure 1 in partially sectioned view,

Figure 3 is a view showing the clamp arms of the medical device connected by a pivot pin in fully open state,

Figure 4 shows a perspective view of the distal part of the medical device with the clamp device,

Figure 5 shows an enlarged perspective view of the clamp base of the clamp device,

Figure 6 shows a further enlarged perspective view of the clamp base of the clamp device,

Figure 7 shows the sheath device of the medical device with a coiled sheath and a connect tube,

Figure 8 corresponds to figure 7 and shows the connect tube mounted to the sheath,

Figure 9 is a perspective view showing the clamp base attached to the sheath device,

Figure 10 is a partially sectioned view of the arrangement of figure 9,

Figure 11 is a partially sectioned view of the clamp device with the clamp arms in fully open state,

Figure 12 is a partially sectioned view of the clamp device with partially closed clamp arms,

Figure 13 is a partially sectioned view of the clamp device with closed clamp arms,

Figure 14 corresponds to figure 13 without sections,

Figure 15 corresponds to figure 13 and shows the arrangement with further retracted control wire,

Figure 16 corresponds to figure 15 with the clamp base in sectional view and the clamp arms in fully closed and secured position,

Figure 17 shows the engagement of the guide pin and the guide grooves of the clamp arms in the position of figure 16 in enlarged scale,

Figures 18 to 20 correspond to figures 15 and 16 and show the process of uncoupling the control wire from the clamp arms,

Figures 21 to 23 are partially sectioned views of the clamp base showing the release of the clamp base from the sheath device,

Figure 24 is a perspective view showing the clamp device separated from the sheath device,

EP 3 725 242 A1

	Figures 25 and 26	are top views of the clamp base before and after disconnecting from the sheath device,
	Figure 27	shows a front view of a medical device according to a second embodiment of the present invention,
5	Figure 28	shows in enlarged scale the front distal part of the medical device of figure 27 in partially sectioned view,
	Figure 29	is a view showing the clamp arms of the medical device connected by a pivot pin in fully open state,
10	Figure 30	shows an enlarged perspective view of the clamp base of the clamp device,
	Figure 31	shows a further enlarged perspective view of the clamp base of the clamp device,
	Figure 32	shows the sheath device of the medical device with a coiled sheath and a connect tube,
15	Figure 33	corresponds to figure 32 and shows the connect tube mounted to the sheath,
	Figure 34	is a perspective view showing the clamp base attached to the sheath device,
20	Figure 35	is a sectioned view of the arrangement of figure 34,
	Figure 36	is a partially sectioned view of the clamp device with the clamp arms in fully open state,
	Figure 37	is a partially sectioned view of the clamp device with partially closed clamp arms,
25	Figure 38	is a partially sectioned view of the clamp device with closed clamp arms,
	Figure 39	corresponds to figure 38 without sections,
30	Figure 40	corresponds to figure 38 and shows the arrangement from a different angle,
	Figure 41	corresponds to figure 40 and shows the arrangement with further retracted control wire,
	Figure 42	corresponds to figure 41 with the clamp base in sectional view and the clamp arms in fully closed and secured position,
35	Figure 43	shows the arrangement of figure 42 in enlarged scale,
	Figures 44 and 45	are partially sectioned views showing the process of uncoupling the control wire from the clamp arms after securing the clamp arms in the closed state,
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	Figures 46 and 47	correspond to figures 41 and 42 and show a process of closing the clamp arms and securing them in the closed state and simultaneously uncoupling the control wire from the clamp arms,
45	Figures 48 to 50	are partially sectioned views of the clamp base showing the release of the clamp base from the sheath device,
	Figure 51	is a perspective view showing the clamp device separated from the sheath device,
50	Figures 52 and 53	are top views of the clamp base before and after disconnecting from the sheath device,
	Figure 54	shows a front view of a medical device according to a third embodiment of the present invention,
	Figure 55	shows in enlarged scale the front, distal part of the medical device of figure 54 in partially sectioned view,
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	Figure 56	is a view showing the clamp arms of the medical device operatively connected to each other by a pivot pin in fully open state,

- Figure 57 shows an enlarged perspective view of the clamp base of the clamp device,
- Figure 58 shows a further enlarged perspective view of the clamp base of the clamp device,
- 5 Figure 59 is a view showing the clamp base attached to the sheath device,
- Figure 60 is a sectional view of the arrangement of figure 59,
- Figure 61 is a partially sectioned view of the clamp device with the clamp arms in fully open state,
- 10 Figure 62 is a partially sectioned view of the clamp device with partially closed clamp arms,
- Figure 63 is a partially sectioned view of the clamp device with closed clamp arms,
- 15 Figure 64 corresponds to figure 63 and shows the arrangement with further retracted control wire,
- Figure 65 corresponds to figure 64 with the clamp base in sectional view and the clamp arms in fully closed and secured position,
- 20 Figure 66 shows the engagement of the guide pin and the guide groove of the clamp arms in the position of figure 65 in enlarged scale,
- Figures 67 to 69 correspond to figure 64 and show the process of uncoupling the control wire from the clamp arms,
- 25 Figures 70 and 71 are partially sectioned views of the clamp base showing the release of the clamp base from the sheath device,
- Figure 72 is a perspective view showing the clamp device separated from the sheath device, and
- 30 Figure 73 is a top view of the clamp base before disconnecting from the sheath device,

[0033] In figures 1 to 26 a first embodiment of a medical device according to the present invention is shown. The medical device is used to set clamps for causing hemostasis of blood vessels located along the gastrointestinal tract, wherein the clamps are delivered to a target site through an endoscope.

35 **[0034]** The medical device comprises a handle 1, a sheath device 2, which is attached to the handle 1, and a clamp device 3 which is provided on the distal end of the sheath device 2. A control wire 4 extends through the sheath device 2 and is at its proximal end connected to an actuator 5, which is slidably held on the handle 1 and can be actuated to reversibly move the control wire 4 in the distal and proximal directions.

40 **[0035]** The clamp device 3 comprises a clamp base 6 formed as a sleeve and two clamp arms 7a, 7b, which are each coupled to the distal end of the control wire 4. Specifically the two clamp arms 7a, 7b are separate elements/components that are coupled to the control wire 4 by means of a pivot pin 8, which is provided at a distal end section of the control wire 4 and extends through corresponding through-holes 9 provided in the proximal end sections of the clamp arms 7a, 7b. In the present embodiment the pivot pin 8 is provided on a coupling head 10, which is provided at the distal end of the control wire 4.

45 **[0036]** The coupling head 10 has a U-shaped or bifurcated holding structure which is open on its distal end, and the clamp arms 7a, 7b are partly arranged between the U-legs of the U-shaped holding structure. The pivot pin 8 is held between the U-legs and extends through the through-holes 9 of the clamp arms 7a, 7b, which in turn extend laterally outwards of the open lateral side of the U-shaped holding structure.

50 **[0037]** The two clamp arms 7a, 7b are coupled to the distal end of the control wire 4 so that they can be rotated around a common pivot axis formed by the pivot pin 8 in order to open and close them. Each clamp arm 7a, 7b is provided with a guide groove 11, and the guide grooves 11 of the clamp arms 7a, 7b partially overlap each other. The clamp device 3 further comprises a guide pin 12, which is attached to the clamp base 6 and extends through the guide grooves 11 in the overlapping parts thereof, so that by the engagement of the guide pin 12 and the guide grooves 11 a movement of the control wire 4 in the proximal direction is translated into a closing movement of the clamp arms 7a, 7b, and a movement of the control wire 4 in a distal direction is translated into an opening movement of the clamp arms 7a, 7b around the pivot axis. In the present embodiment the guide pin 12 is held between two bearing arms 13a, 13b extending upright from the distal end of the clamp base 6 forming a bifurcated structure, the clamp arm 6a, 6b being arranged between those bearing arms 13a, 13b extending laterally outward of the structure. The clamp base 6 and the bearing arms 13a,

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13b together form a clamp housing.

[0038] As in particular shown in figure 3 the through-holes 9 for the pivot pin 8 in the proximal end sections of the clamp arms 7a, 7b are open to their rear (proximal) side. In other words exit-passages 14 are provided in the tail ends of the clamp arms 7a, 7b at the proximal sides of the through-holes 9, through which after closing the clamp arms 7a, 7b the pivot pin 8 can be pulled out of the through-holes 9 spreading apart the tail end sections 15, 16 of the clamp arms 7a, 7b on the opposite sides of the openings without breaking. In this way the control wire 4 is uncoupled from the clamp arms 7a, 7b and accordingly the clamp device 3. The exit-passages 14 are here formed by slits in the tail ends of the clamp arms 7a, 7b.

[0039] In the first embodiment the tail end sections 15, 16 of the clamp arms 7a, 7b are plastically deformed, when they are spread apart and formed as hooks, which are to be brought into engagement behind a shoulder 17 of the clamp base 6 in order to lock the clamp arms 7a, 7b therein, as will be explained in detail later. The shoulder 17 is formed by an annular, inwardly directed projection that is provided at the distal end of the clamp base 6 and forms the distal end face thereof.

[0040] The sheath device 2 includes a coiled sheath 2a, which is connected to the handle 1, and a connect tube 2b, which is provided on the distal end of the coiled sheath 2a and laser welded thereto, so that the sheath device 2 forms an inseparable unit. The sheath device 2 is connected to the clamp base 6 by means of two connecting elements 18 in the form of elastic connecting arms that are formed in a one piece construction with the clamp base 6 on opposite sides thereof. Specifically the distal ends of the connecting elements 18 are fixedly connected to the clamp base 6, whereas the free proximal ends of the connecting elements 18 form engagement portions that engage corresponding engagement means provided on the circumferential surface of the connect tube 2b, in order to couple the clamp base 6 to the sheath device 2. Here the engagements portions of the connecting elements 18 are formed as inwardly directed engagement portions, which engage a ring groove 19 which is provided as engagement means in the outer surface of the connect tube 2b, in order to couple the clamp base 6 to the sheath device 2.

[0041] As obtainable from figure 2 the distal end of the connect tube 2b extends into the sleeve-like clamp base 6, so that the ring groove 19 is positioned within the clamp base 6.

[0042] The connecting elements 18 have inwardly bulged sections 18a in their middle portions. These inwardly bulged sections 18a cooperate with a protrusion 20 of the control wire 4, which forms part of a release arrangement and can be actuated by movement of the control wire 4 in the proximal direction in order to release the clamp base 6 from the sheath device 2, when the clamp arms 7a, 7b have been closed. In detail the protrusion 20 is formed by the rear, proximal part of the coupling head 10 of the control wire 4 and provided to come into engagement with the inwardly bulged sections 18a of the connecting elements 18, so that when the control wire 4 is pulled in proximal direction the bulged sections 18a of the connecting elements 18 are plastically deformed outwardly by the engagement with the protrusions 20 and thus the free ends of the connecting elements 18 are disengaged from the ring groove 19 of the connect tube 2b.

[0043] In use the clamp device 3 is delivered to the target site through an endoscope, and the clamp device 3 is fixed at a predetermined position on the target site to a blood vessel. In order to pinch the blood vessel the clamp arms 7a, 7b can be repeatedly opened and closed by moving the control wire 4 in the distal and proximal direction by means of the actuator 5.

[0044] Once the clamp device 3 has been set the clamp arms 7a, 7b are to be disconnected from the control wire 4. For this purpose the control wire 4 is pulled in proximal direction in order to fully close the clamp arms 7a, 7b and secure them in the closed position, as depicted in figures 17 to 19. These figures show, that the guide grooves 11 have a straight, axially extending distal end section 11a, in which the guide pins 12 can move without incurring further rotation of the clamp arms 7a, 7b. When the guide pins 12 reach their front, distal end positions in the guide grooves 11, they are secured/locked in this position by holding noses 21 provided on the clamp arms 7a, 7b. The holding noses 21 extend into the straight end sections 11a of the guide grooves 11 from a lateral side thereof and are designed in such a way, that they allow the guide pins 12 to pass them to reach the proximal ends of the guide grooves 12 but prevent passing of the guide pins 12 in the opposite direction. Specifically the holding noses 21 are designed such that they elastically deform into recesses 11b in the lateral sides of the guide grooves 11 when the guide pins 12 press against their proximal side to allow the guide pins 12 to pass the holding noses 21 and reach their distal end positions in the guide grooves 11, that they regain their initial form by their elastic restoring force to engage behind the guide pins 12, when the guide pins 12 have reached their final positions, but that they cannot be deformed to open the guide grooves 11 when the guide pins 12 press against their distal side, so that the guide pins 12 are captured in their distal end positions in the guide grooves 11. In this way the clamp arms 7a, 7b are securely locked to the clamp base 6 and accordingly the clamp housing.

[0045] If the control wire 4 is further pulled back, a further transitional movement of the clamp arms 7a, 7b is no more possible, and insofar the pivot pin 8 is pulled out of the through-holes 9 through the exit-passages 14 on the rear side thereof. During this process the tail end sections 15, 16 located on the opposite side of the exit-passages 14 are plastically spread apart to engage behind the shoulder 17 of the clamp base 6, thus locking the clamp arms 7a, 7b to the clamp base 6.

[0046] In order to uncouple/release the clamp base 6 from the sheath device 2, the control wire 4 is further pulled

back in proximal direction, so that the protrusion 20 of the coupling head 10 comes into engagement with the inwardly bulged sections 18a of the connecting elements 18 (see figure 23a) and pushes the bulged sections 18a outwardly plastically deforming them, thus bringing the free end of the connecting elements 18 out of engagement from the ring groove 19 of the connect tube 2b (figures 23b, 23c), so that the clamp device 3 with the clamp base 6 and the clamp arms 7a, 7b can be pulled from the sheath device 2.

[0047] Figures 27 to 53 show a second embodiment of a medical device according to a second embodiment of the invention. The basic design of the second embodiment corresponds to the first embodiment. The embodiments only differ in the specific ways, in which the control wire 4 is coupled to the clamp arms 7a, 7b and the design and function of the connecting elements 18.

[0048] The medical device according the second embodiment comprises a handle 1, a sheath device 2, which is attached to the handle 1, and a clamp device 3 which is provided on the distal end of the sheath device 2. A control wire 4 extends through the sheath device 2 and is at its proximal end connected to an actuator 5, which is slidably held on the handle 1 and can be actuated to reversibly move the control wire 4 in the distal and proximal directions.

[0049] The clamp device 3 comprises a clamp base 6 formed as a sleeve and two clamp arms 7a, 7b, which are each coupled to the distal end of the control wire 4. Specifically the two clamp arms 7a, 7b are separate elements/components that are coupled to the control wire 4 by means of a pivot pin 8, which is provided at a distal end section of the control wire 4 and extends through corresponding through-holes 9 provided in the proximal end sections of the clamp arms 7a, 7b. In the present embodiment the pivot pin 8 is provided on a coupling head 10, which is provided at the distal end of the control wire 4. In the second embodiment the coupling head 10 is flat and arranged between the clamp arms 7a, 7b, and the pivot pin 8 has two pivot pin sections 8a, 8b extending from opposite sides of the coupling head 10 to engage the respective through-holes 9 in the clamp arms 6a, 6b.

[0050] The two clamp arms 7a, 7b are coupled to the distal end of the control wire 4 so that they can be rotated around a common pivot axis formed by the pivot pin 8 in order to open and close them.

[0051] Each clamp arm 7a, 7b is provided with a guide groove 11, and the guide grooves 11 of the clamp arms 7a, 7b partially overlap each other. The clamp device 3 further comprises a guide pin 12, which is attached to the clamp base 6 and extends through the guide grooves 11 in the overlapping parts thereof, so that by the engagement of the guide pin 12 and the guide grooves 11 a movement of the control wire 4 in the proximal direction is translated into a closing movement of the clamp arms 7a, 7b, and a movement of the control wire 4 in a distal directed in translated into an opening movement of the clamp arms 7a, 7b around the pivot axis. In the present embodiment the guide pin 12 is held between two bearing arms 13a, 13b extending upright from the distal end of the clamp base 6 forming a bi-furcated structure, the clamp arm 6a, 6b being arranged between those bearing arms 13a, 13b extending laterally outward of the structure. The clamp base 6 and the bearing arms 13a, 13b together form a clamp housing.

[0052] The through-holes 9 for the pivot pin 8 in the proximal end sections of the clamp arms 7a, 7b are open to their rear (proximal) side. In other words exit-passages 14 are provided in the tail ends of the clamp arms 7a, 7b at the proximal sides of the through-holes 9, through which after closing the clamp arms 7a, 7b the pivot pin 8 can be pulled out of the through-holes 9 spreading apart the tail end sections 15, 16 of the clamp arms 7a, 7b on the opposite sides of the openings without breaking. In this way the control wire 4 is uncoupled from the clamp arms 7a, 7b and accordingly the clamp device 3. The exit-passages 14 are here formed by slits in the tail ends of the clamp arms 7a, 7b.

[0053] In the second embodiment the tail end sections 15, 16 of the clamp arms 7a, 7b are elastically deformed, when they are spread apart, and they are formed as hooks, which engage behind a shoulder 17 of the clamp base 6 in order to lock the clamp arms 7a, 7b therein. The shoulder 17 is formed by an annular, inwardly directed projection that is provided at the distal end of the clamp base 6 and forms the distal end surface thereof. (figures 44 and 45)

[0054] The sheath device 2 includes a coiled sheath 2a, which is connected to the handle 1, and a connect tube 2b, which is provided on the distal end of the coiled sheath 2a and laser welded thereto, so that the sheath device 2 forms an inseparable unit. The sheath device 2 is connected to the clamp base 6 by means of two connecting elements 18 in the form of elastic connecting arms that are formed in a one piece construction with the clamp base 6 on opposite sides thereof. Specifically the distal ends of the connecting elements 18 are fixedly connected to the clamp base 6, whereas the free proximal ends of the connecting elements 18 from engagement portions that engage corresponding engagement means provided on the on the circumferential surface of the connect tube 2b, in order to couple the clamp base 6 to the sheath device 2. Here the engagements portions of the connecting elements 18 are formed as inwardly directed engagement portions, which engage a ring groove 19 which is provided as engagement means in the outer surface of the connect tube 2b, in order to couple the clamp base 6 to the sheath device 2.

[0055] As obtainable from figure 28 the distal end of the connect tube 2b extends into the sleeve-like clamp base 6, so that the ring groove 19 is positioned within the clamp base 6.

[0056] The connecting elements 18 of the second embodiment are formed as C-shaped connecting arms, wherein the central bar of the C-shaped connecting arm is attached at a connection site on opposing sides thereof to the clamp base 3 by two plastically deformable narrow webs 22, a distal C-leg extends inwardly into the clamp base 3, so that it can be engaged by the protrusion 20, and the other proximal C-leg forming the engagement portion extends inwardly

to engage the ring groove 19 of the connect tube 2b. The arrangement is such, that if - in the closed position of the clamp arms 7a, 7b - the control wire 4 is pulled in proximal direction, the protrusion 20 engages the distal C-legs so that the connecting elements 18 are pivoted around their connection sites defined by the opposing webs 22 to move the proximal C-legs out of engagement from the ring groove 19. (see figures 48 to 50)

[0057] In use the clamp device 3 is delivered to the target site through an endoscope, and the clamp device 3 is fixed at a predetermined position on the target site to a blood vessel. In order to pinch the blood vessel the clamp arms 7a, 7b can be repeatedly opened and closed by moving the control wire 4 in the distal and proximal direction by means of the actuator 5.

[0058] Once the clamp device 3 has been set the clamp arms 7a, 7b are to be disconnected from the control wire 4. For this purpose the control wire 4 is pulled in proximal direction in order to fully close the clamp arms 7a, 7b and secure them in the closed position, as depicted in figures 17 to 19. These figures show, that the guide grooves 11 have a straight, axially extending distal end section 11a, in which the guide pins 12 can move without incurring further rotation of the clamp arms 7a, 7b. When the guide pins 12 reach their front, distal end positions in the guide grooves 11, they are secured/locked in this position by holding noses 21 provided on the clamp arms 7a, 7b. The holding noses 21 extend into the straight end sections 11a of the guide grooves 11 from a lateral side thereof and are designed in such a way, that they allow the guide pins 12 to pass them to reach the proximal ends of the guide grooves 12 but prevent passing of the guide pins 12 in the opposite direction. Specifically the holding noses 21 are designed such that they elastically deform into recesses 11b in the lateral sides of the guide grooves 11 when the guide pins 12 press against their proximal side to allow the guide pins 12 to pass the holding noses 21 and reach their distal end positions in the guide grooves 11, that they regain their initial form by their elastic restoring force to engage behind the guide pins 12, when the guide pins 12 have reached their final positions, but that they cannot be deformed to open the guide grooves 11 when the guide pins 12 press against their distal side, so that the guide pins 12 are captured in their distal end positions in the guide grooves 11. In this way the clamp arms 7a, 7b are securely locked to the clamp base 6 and accordingly the clamp housing. (see figure 42)

[0059] If the control wire 4 is further pulled back, a transitional movement of the clamp arms 7a, 7b is no more possible, and insofar the pivot pin 8 is pulled out of the through-holes 9 through the exit-passages 14 on the rear side thereof. During this process the tail end sections 15, 16 located on the opposite side of the exit-passages 14 are elastically spread apart to open the exit-passages, but return in their original form once the pivot pin 8 has left the exit-passages 14. In order to uncouple/release the clamp base 6 from the sheath device 2, the control wire 4 is further pulled back in proximal direction, so that the protrusion 20 of the coupling head 10 comes into engagement with the inwardly directed distal C-legs of the connecting elements 18 (see figure 23a) and pushes these C-legs in proximal direction with the result, that the connecting elements 16 are pivoted around the connection site defined by the opposing webs 22 to move the proximal C-leg out of engagement from the ring groove 17. (figures 48 to 56)

[0060] During the closing process of the clamp arms 7a, 7b the tail ends of the clamp arms 7a, 7b enter the clamp base 6 through the central opening of the ring shaped shoulder 17. As obtainable from figures 36 to 38 the lateral extension of the clamp arms 7a, 7b exceeds the diameter of the opening, so that the clamp arms 7a, 7b are elastically compressed when they enter the clamp base 6 and after re-expansion engage behind the shoulder 17 of the clamp base 6 in order to lock the clamp arms 7a, 7b to the clamp base 6.

[0061] As shown in figures 46 and 47 the process of closing the clamp arms and securing them in the closed state can be performed simultaneously to uncoupling the control wire 4 from the clamp arms 7a, 7b.

[0062] A third embodiment of a medical device according to the present invention is shown in figures 54 to 73.

[0063] The medical device according the second embodiment comprises a handle 1, a sheath device 2, which is attached to the handle 1, and a clamp device 3 which is provided on the distal end of the sheath device 2. A control wire 4 extends through the sheath device 2 and is at its proximal end connected to an actuator 5, which is slidably held on the handle 1 and can be actuated to reversibly move the control wire 4 in the distal and proximal directions.

[0064] The clamp device 3 comprises a clamp base 6 formed as a sleeve and two clamp arms 7a, 7b, which are each coupled to the distal end of the control wire 4. Specifically the two clamp arms 7a, 7b are separate elements/components that are coupled to the control wire 4 by means of a pivot pin 8, which is provided at a distal end section of the control wire 4 and extends through corresponding through-holes 9 provided in the proximal end sections of the clamp arms 7a, 7b. In the present embodiment the pivot pin 8 is provided on a coupling head 10, which is provided at the distal end of the control wire 4. In the second embodiment the coupling head 10 is flat and arranged between the clamp arms 7a, 7b, and the pivot pin 8 has two pivot pin sections 8a, 8b extending from opposite sides of the coupling head 10 to engage the respective through-holes 9 in the clamp arms 6a, 6b.

[0065] The two clamp arms 7a, 7b are coupled to the distal end of the control wire 4 so that they can be rotated around a common pivot axis formed by the pivot pin 8 in order to open and close them.

[0066] Each clamp arm 7a, 7b is provided with a guide groove 11, and the guide grooves 11 of the clamp arms 7a, 7b partially overlap each other. The clamp device 3 further comprises a guide pin 12, which is attached to the clamp base 6 and extends through the guide grooves 11 in the overlapping parts thereof, so that by the engagement of the

guide pin 12 and the guide grooves 11 a movement of the control wire 4 in the proximal direction is translated into a closing movement of the clamp arms 7a, 7b, and a movement of the control wire 4 in a distal direction is translated into an opening movement of the clamp arms 7a, 7b around the pivot axis.

[0067] The through-holes 9 for the pivot pin 8 in the proximal end sections of the clamp arms 7a, 7b are open to their rear (proximal) side. In other words exit-passages 14 are provided in the tail ends of the clamp arms 7a, 7b at the proximal sides of the through-holes 9, through which after closing the clamp arms 7a, 7b the pivot pin 8 can be pulled out of the through-holes 9 spreading apart the tail end sections 15, 16 of the clamp arms 7a, 7b on the opposite sides of the openings without breaking. In this way the control wire 4 is uncoupled from the clamp arms 7a, 7b and accordingly the clamp device 3. The exit-passages 14 are here formed by slits in the tail ends of the clamp arms 7a, 7b.

[0068] In the third embodiment the tail end sections 15, 16 of the clamp arms 7a, 7b are plastically deformed, when they are spread apart, and they are formed as hooks, which engage behind a shoulder 17 of the clamp base 6 in order to lock the clamp arms 7a, 7b therein, as will be described. The shoulder 17 is formed by an annular, inwardly directed projection that is provided at the distal end of the clamp base 6 and forms the distal end surface thereof.

[0069] The sheath device 2 includes a coiled sheath 2a, which is connected to the handle 1, and a connect tube 2b, which is provided on the distal end of the coiled sheath 2a and laser welded thereto, so that the sheath device 2 forms an inseparable unit. The sheath device 2 is connected to the clamp base 6 by means of two connecting elements 18 in the form of elastic connecting arms that are formed in a one piece construction with the connect tube 2b on opposite sides thereof. Specifically the proximal ends of the connecting elements 18 are fixedly connected to the connect tube 2b, whereas the free distal ends of the connecting elements 18 form engagement portions that engage a circumferential groove 19 which is provided in the outer surface of the clamp base 3, in order to couple the clamp base 6 to the sheath device 2.

[0070] As obtainable from the figures the proximal end of the clamp base 6 extends into the connect tube 2b.

[0071] The connecting elements 18 are provided in the form of resilient, elastically deformable connecting arms or connecting wires of which the proximal end is attached to the connect tube 2b and the distal end extends out of the connect tube 2b through an opening 23 in the circumferential wall thereof and forms an engagement portion which engages a ring groove 19 provided in the outer circumferential surface of the clamp base 3. Specifically the proximal ends of the connecting elements 18 are fixed to the inner face of the connect tube 2b, namely inserted into corresponding radial bores in the connect tube 2b. The connecting elements 18 have inwardly bulged portions 18a located in the connect tube 2b, and on the distal side of the bulged portion 18a the connecting elements 18 extend out of the connect tube 2b through windows 23 provided in the circumferential wall of the connect tube 2 (see fig. 70).

[0072] A release arrangement for disconnecting the clamp base 3 from the connect tube 2b is provided. This release arrangement comprises a protrusion 20 provided on the control wire 4. The protrusion 20 cooperates with and is located between the inwardly bulged sections 18a of the connecting elements 18 to press the inwardly bulged sections 18a outwardly elastically deforming the connecting element 18 in such a way that their free ends are pressed inwardly into the ring groove 19 of the clamp base 3. When the control wire 4 is pulled proximally and the protrusion 20 comes out of engagement of the connecting elements 18, the bulged sections 18a are re-deformed inwardly by their elastic restoring force to obtain their original shape and the connecting portions come out of engagement of the ring groove 19.

[0073] In order to obtain that function provision is made that when in engagement with the protrusion 20 the connecting elements 18 are pushed outwardly, the distal sections thereof are pressed against slanted abutment faces 24 on the proximal side of the windows 23 leading to an inward deformation of the distal ends of the connecting elements 18 so that their connecting portions are pressed into the ring groove 17. When the protrusion 20 comes out of engagement from the connecting elements 18 the later regain their original shape. As a consequence the distal ends of the connecting elements 18 come out of contact from the corresponding abutment faces 24 and are thus deformed to leave the ring groove 17.

[0074] In use the clamp device 3 is delivered to the target site through an endoscope, and the clamp device 3 is fixed at a predetermined position on the target site to a blood vessel. In order to pinch the blood vessel the clamp arms 7a, 7b can be repeatedly opened and closed by moving the control wire 4 in the distal and proximal direction by means of the actuator 5.

[0075] Once the clamp device 3 has been set the clamp arms 7a, 7b are to be disconnected from the control wire 4. For this purpose the control wire 4 is pulled in proximal direction in order to fully close the clamp arms 7a, 7b and secure them in the closed position, as depicted in figures 17 to 19. These figures show, that the guide grooves 11 have a straight, axially extending distal end section 11a, in which the guide pins 12 can move without incurring further rotation of the clamp arms 7a, 7b. When the guide pins 12 reach their front, distal end positions in the guide grooves 11, they are secured/locked in this position by holding noses 21 provided on the clamp arms 7a, 7b. The holding noses 21 extend into the straight end sections 11a of the guide grooves 11 from a lateral side thereof and are designed in such a way, that they allow the guide pins 12 to pass them to reach the proximal ends of the guide grooves 12 but prevent passing of the guide pins 12 in the opposite direction. Specifically the holding noses 21 are designed such that they elastically deform into recesses 11b in the lateral sides of the guide grooves 11 when the guide pins 12 press against their proximal

side to allow the guide pins 12 to pass the holding noses 21 and reach their distal end positions in the guide grooves 11, that they regain their initial form by their elastic restoring force to engage behind the guide pins 12, when the guide pins 12 have reached their final positions, but that they cannot be deformed to open the guide grooves 11 when the guide pins 12 press against their distal side, so that the guide pins 12 are captured in their distal end positions in the guide grooves 11. In this way the clamp arms 7a, 7b are securely locked to the clamp base 6 and accordingly the clamp housing.

[0076] If the control wire 4 is further pulled back, a transitional movement of the clamp arms 7a, 7b is no more possible, and insofar the pivot pin 8 is pulled out of the through-holes 9 through the exit-passages 14 on the rear side thereof. During this process the tail end sections 15, 16 located on the opposite side of the exit-passages 14 are plastically spread apart to open the exit-passages 14.

[0077] In order to uncouple/release the clamp base 6 from the sheath device 2, the control wire 4 is further pulled back in proximal direction, so that the protrusion 20 of the coupling head 10 comes out of engagement from the inwardly bulged portions 18a of the connecting elements 18 so that the connecting elements 18 regain the initial shape in which their free ends come out of engagement from the ring groove 19 of the clamp base 3.

[0078] During the closing process of the clamp arms 7a, 7b the tail ends of the clamp arms 7a, 7b enter the clamp base 6 through the central opening of the ring shaped shoulder 17 so that they engage behind the shoulder 17 of the clamp base 3 in order to lock the clamp arms 7a, 7b to the clamp base 3.

1	handle
2	sheath device
2a	sheath
2b	connect tube
3	clamp device
4	control wire
5	actuator
6	clamp base
7a, 7b	clamp arm
8	pivot pin
8a, 8b	pivot pin sections
9	through-holes
10	coupling head
11	guide groove
11a	straight distal end section
11b	recess
12	guide pin
13a, 13b	bearing arm
14	axid-passage
15, 16	tail end sections
17	shoulder
18	connecting element
18a	bulged section
19	groove
20	protrusion
21	holding noses
22	webs
23	windows
24	abutment faces

Claims

1. A medical device for causing the hemostasis of a blood vessel for use through an endoscope, said medical device comprising:

a handle (1);
 a sheath device (2), which is attached to the handle (1);
 a clamp device (3) including a clamp base (6) in particular in the form of a sleeve provided on the distal end of the sheath device (2) and at least or exactly two clamp arms;

a control wire (4) extending through the sheath device (2) and reversibly movable in the distal and proximal directions; and

an actuator (5) coupled to the proximal end of the control wire (4) and actuatable to reversibly move the control wire (4) in the distal and proximal directions;

wherein the clamp arms (7a, 7b) are each coupled to the distal end of the control wire (4) and wherein the clamp device (3) is actuatable to open and close the clamp arms by a movement of the control wire (4) such that a movement of the control wire (4) in the proximal direction is translated into a closing movement of the clamp arms (7a, 7b) and a movement of the control wire (4) in the distal direction is translated to an opening movement of the clamp arms (7a, 7b);

characterized in that the clamp arms (7a, 7b) are coupled to the control wire (4) by means of a pivot pin (8) which is provided at the distal end section of the control wire (4) and extends through corresponding through-holes (9) provided in the proximal end sections of the clamp arms (7a, 7b), and that exit-passages (14) are provided in the tail ends of the clamp arms, through which after closing the clamp arms (7a, 7b) the pivot pin (8) can be pulled out of engagement from the through-holes (9) and from the clamp arms spreading apart the tail end sections (15, 16) of the clamp arms (7a, 7b) on the opposite sides of the exit-passages (14) without breaking them by a proximal movement of the control wire (4) in order to uncouple the control wire (4) from the clamp arms.

2. A medical device according to claim 1, **characterized in that** the exit-passages (14) are formed by slits in the tail ends of the clamp arms (7a, 7b).

3. A medical device according to any of the preceding claims, **characterized in that** the tail end sections (15, 16) of the clamp arms (7a, 7b) are elastically deformed, when they are spreaded apart.

4. A medical device according to claim 1 or 2 **characterized in that** the proximal ends of the clamp arms (7a, 7b) are plastically deformed, when they are spreaded apart.

5. A medical device according to claim 3 or 4, **characterized in that** the tail end sections (15, 16) of the clamp arms (7a, 7b) on the opposite sides of the exit-passages (14) engage behind at least one shoulder (17) of the clamp base (6) in order to lock the clamp arms (7a, 7b) to the clamp base (6).

6. A medical device according to claim 5, **characterized in that** the tail end sections (15, 16) of the clamp arms (7a, 7b) on the opposite sides of the exit-passages (14) form hooks that engage behind the at least one shoulder (17) of the clamp base (6) in order to lock the clamp arms (7a, 7b) to the clamp base (6).

7. A medical device according to claim 5 or 6, **characterized in that** the shoulder (17) is formed by an annular projection of the clamp base (6), wherein the annular projection in particular forms the distal end face of the clamp base (6) with a central opening, through which the tail end sections of the clamp arms (7a, 7b) extend into the clamp base (6) when the clamp arms are fully closed.

8. A medical device according to any of the preceding claims, **characterized in that** a coupling head (10) is provided at the distal end of the control wire (4), and that the pivot pin (8) is provided on the coupling head (10).

9. A medical device according to claim 8, **characterized in that** the pivot pin (8) has two pivot pin sections, extending from opposite sides of the coupling head (10) into the through-holes (9) of the clamp arms which are positioned on opposite sides of the coupling head (10).

10. A medical device according to claim 8, **characterized in that** the coupling head (10) includes a U-shaped holding structure open to its distal side, wherein the clamp arms (7a, 7b) are partly arranged between the U-legs and the pivot pin (8) is held between the U-legs and extends through the through-holes of the clamp arms (7a, 7b), and wherein, in particular, the clamp arms (7a, 7b) extend laterally outwards of the open lateral side of the U-shaped holding structure.

11. A medical device for causing the hemostasis of a blood vessel for use through an endoscope, said medical device comprising:

a handle (1);

a sheath device (2), which is attached to the handle (1);

a clamp device (3) including a clamp base (6) in particular in the form of a sleeve provided on the distal end of the sheath device (2) and at least or exactly two clamp arms;

a control wire (4) extending through the sheath device (2) and reversibly movable in the distal and proximal directions; and

an actuator (5) coupled to the proximal end of the control wire (4) and actuatable to reversibly move the control wire (4) in the distal and proximal directions;

wherein the clamp arms (7a, 7b) are each coupled to the distal end of the control wire (4) and wherein the clamp device (3) is actuatable to open and close the clamp arms by a movement of the control wire (4) such that a movement of the control wire (4) in the proximal direction is translated into a closing movement of the clamp arms (7a, 7b) and a movement of the control wire (4) in the distal direction is translated into an opening movement of the clamp arms (7a, 7b);

in particular according to any of the preceding claims, **characterized in that** the clamp device includes exactly two clamp arms (7a, 7b) which are provided as separate elements which are coupled to the distal end of the control wire (4) in a pivotal manner around a common pivot axis defined by a pivot pin (8), wherein each clamp arm (7a, 7b) is provided with a guide groove (11) and the guide grooves (11) of the two clamp arms (7a, 7b) partially overlap each other, and

a guide pin (12) which is attached to the clamp base (6) and extends through the guide grooves (11) in the overlapping parts thereof, so that by the engagement of the guide pin (12) and the guide grooves (11) a movement of the control wire (4) in the proximal direction is translated into a closing movement of the clamp arms (7a, 7b) and a movement of the control wire (4) in the distal direction is translated into an opening movement of the clamp arms (7a, 7b) around the pivot axis.

12. A medical device according to claim 11, **characterized in that** the guide pin (12) is held between two bearing arms (13a, 13b) extending in the distal direction from the clamp base (6) in particular at the free end sections of the bearing arms (13a, 13b).

13. A medical device according claim 11 or 12, **characterized in that** holding noses (21) are provided on the clamp arms (7a, 7b), the holding noses (21) extending into the guide grooves (11) from a lateral sides thereof and being designed in such a way, that they allow the guide pins (12) to pass them to reach the distal ends of the guide grooves (11) but prevent passing of the guide pins (12) in the opposite direction, wherein, in particular, the guide grooves (11) have a straight, axially extending distal end section (11a), in which the guide pins (12) can move without incurring rotation of the clamp arms (7a, 7b) and the holding noses (21) extend into the straight distal end sections (11a).

14. A medical device according to claim 12 or 13, **characterized in that** recesses (11b) are formed in the lateral sides of the guide grooves (11) on the distal side of the holding nose (21), into which the holding noses (21) are elastically deformed to allow the guide pins (12) to pass the holding noses (21) and reach their distal end positions in the guide grooves (11).

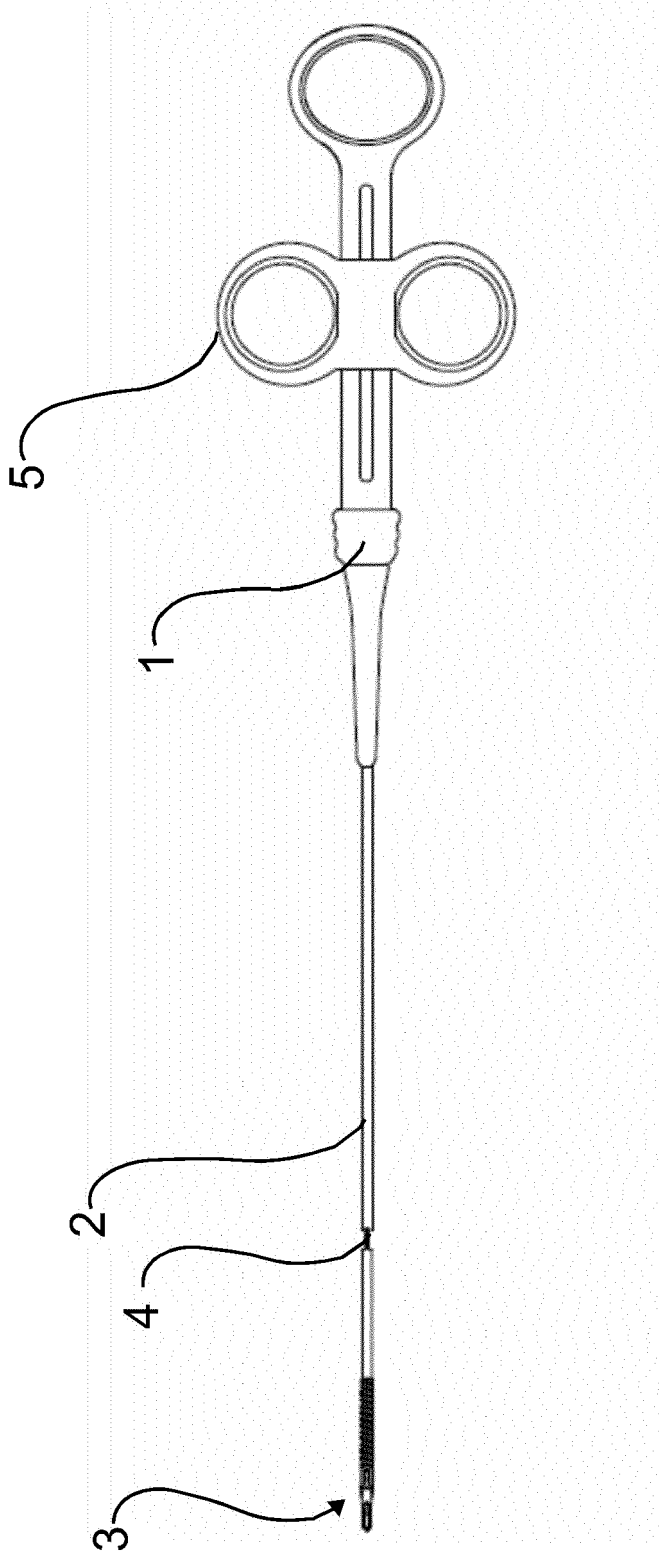


Fig. 1

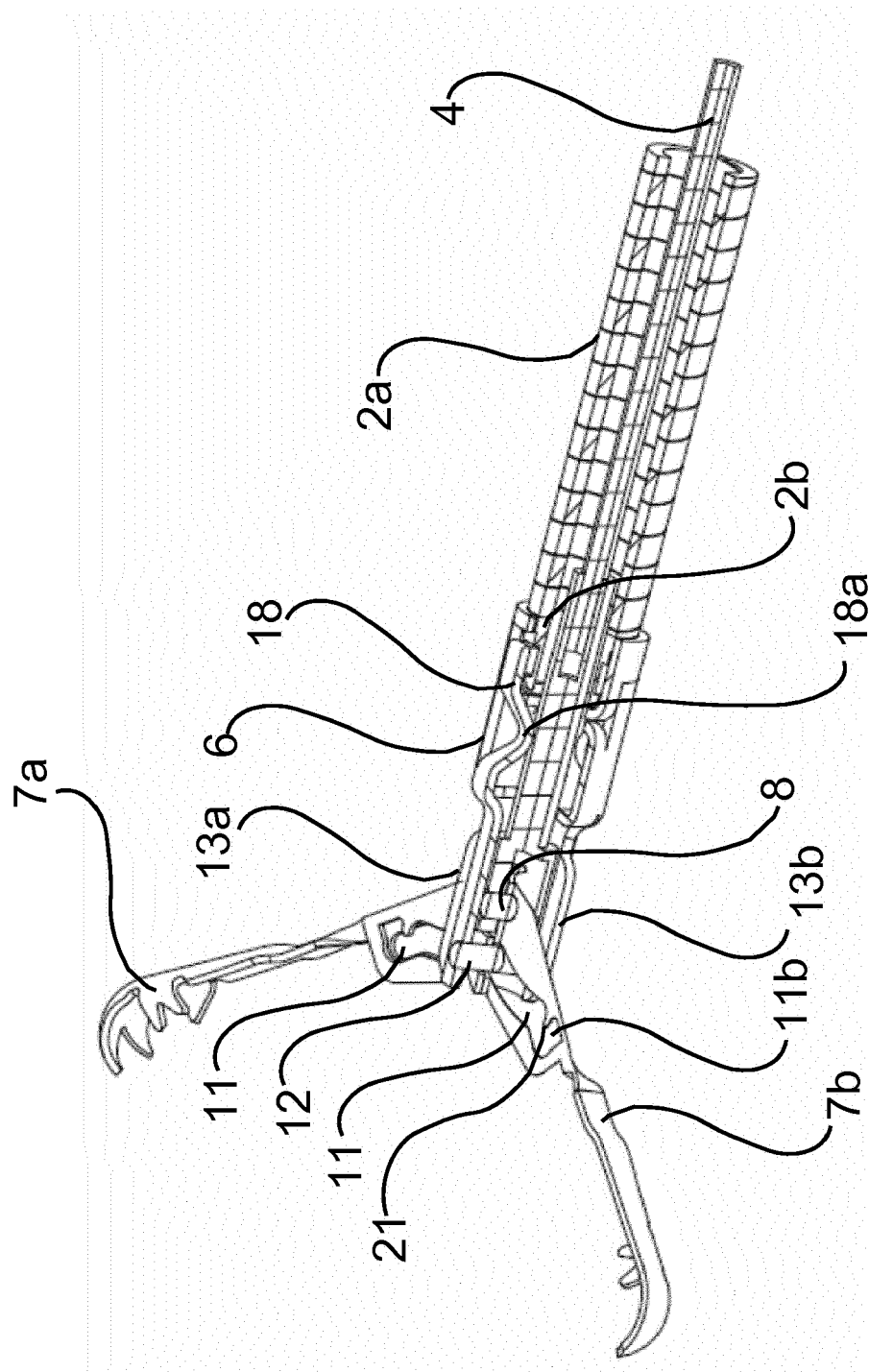


Fig. 2

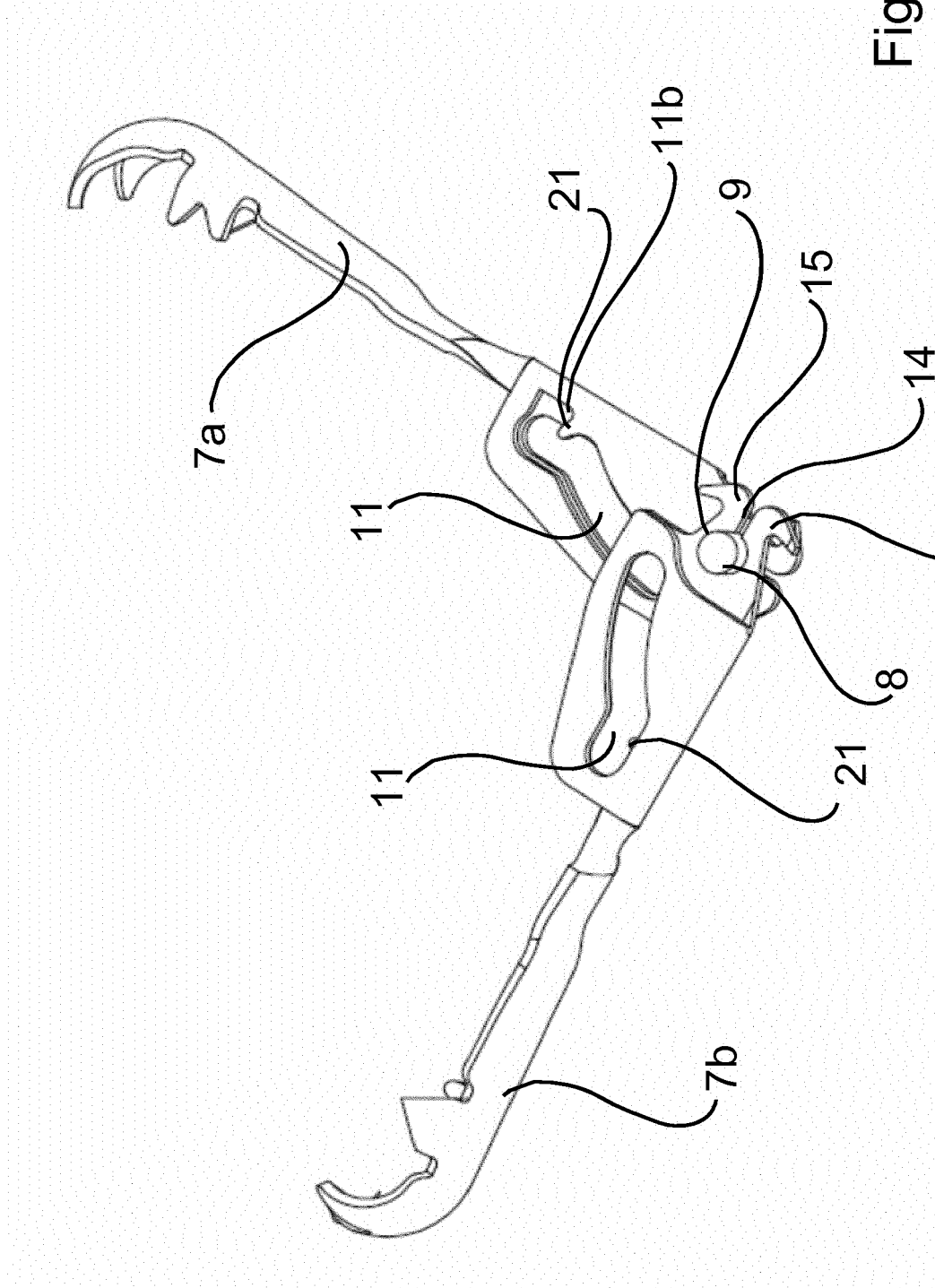


Fig. 3

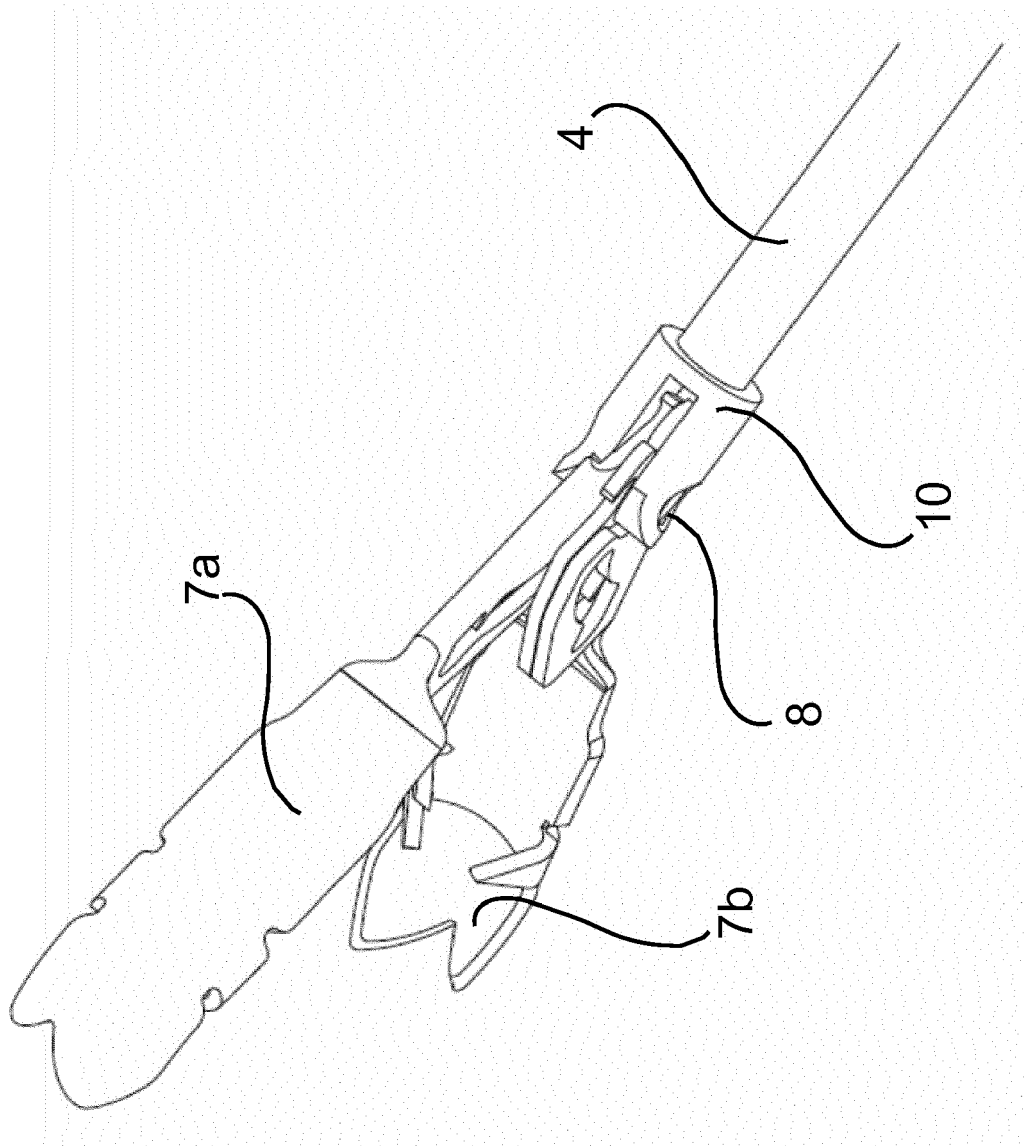


Fig. 4

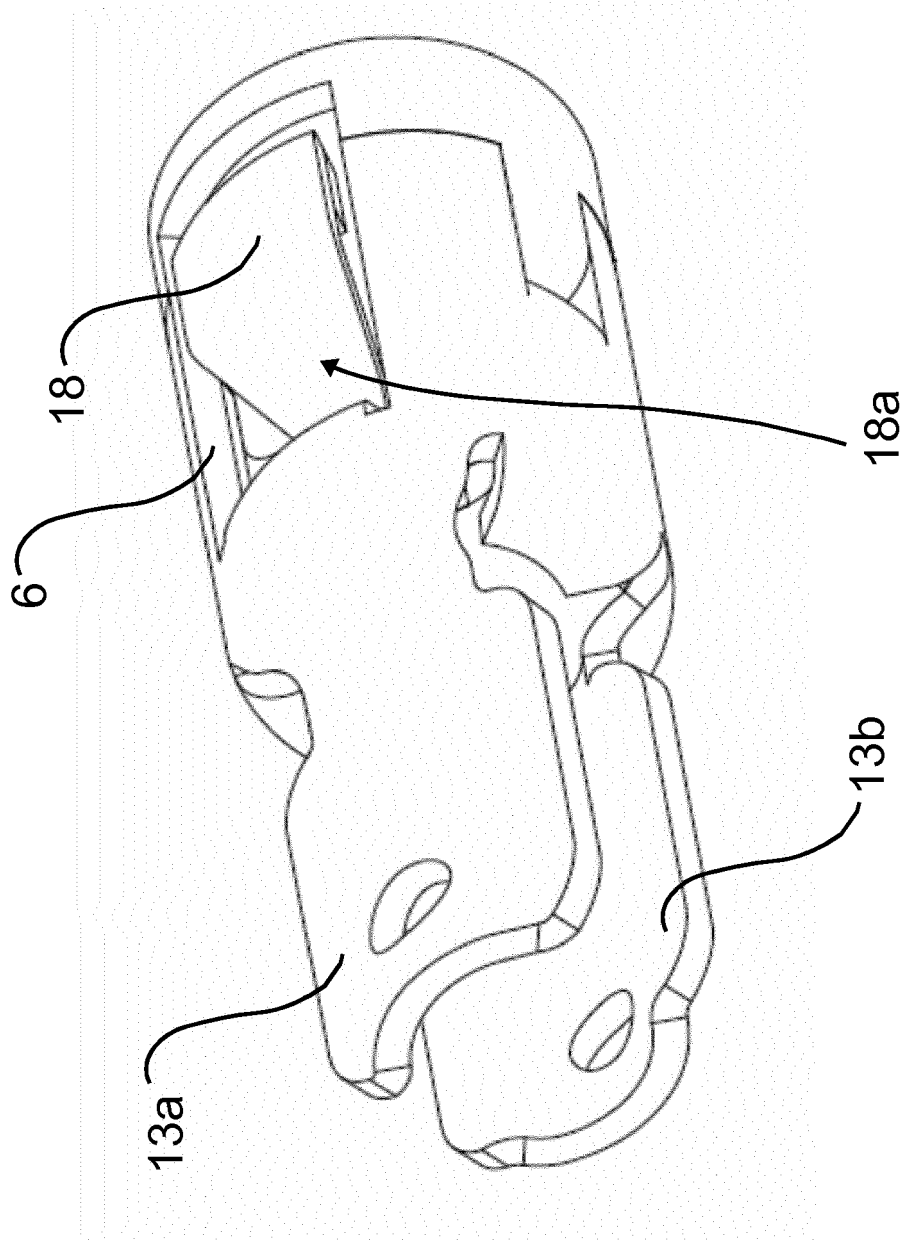


Fig. 5

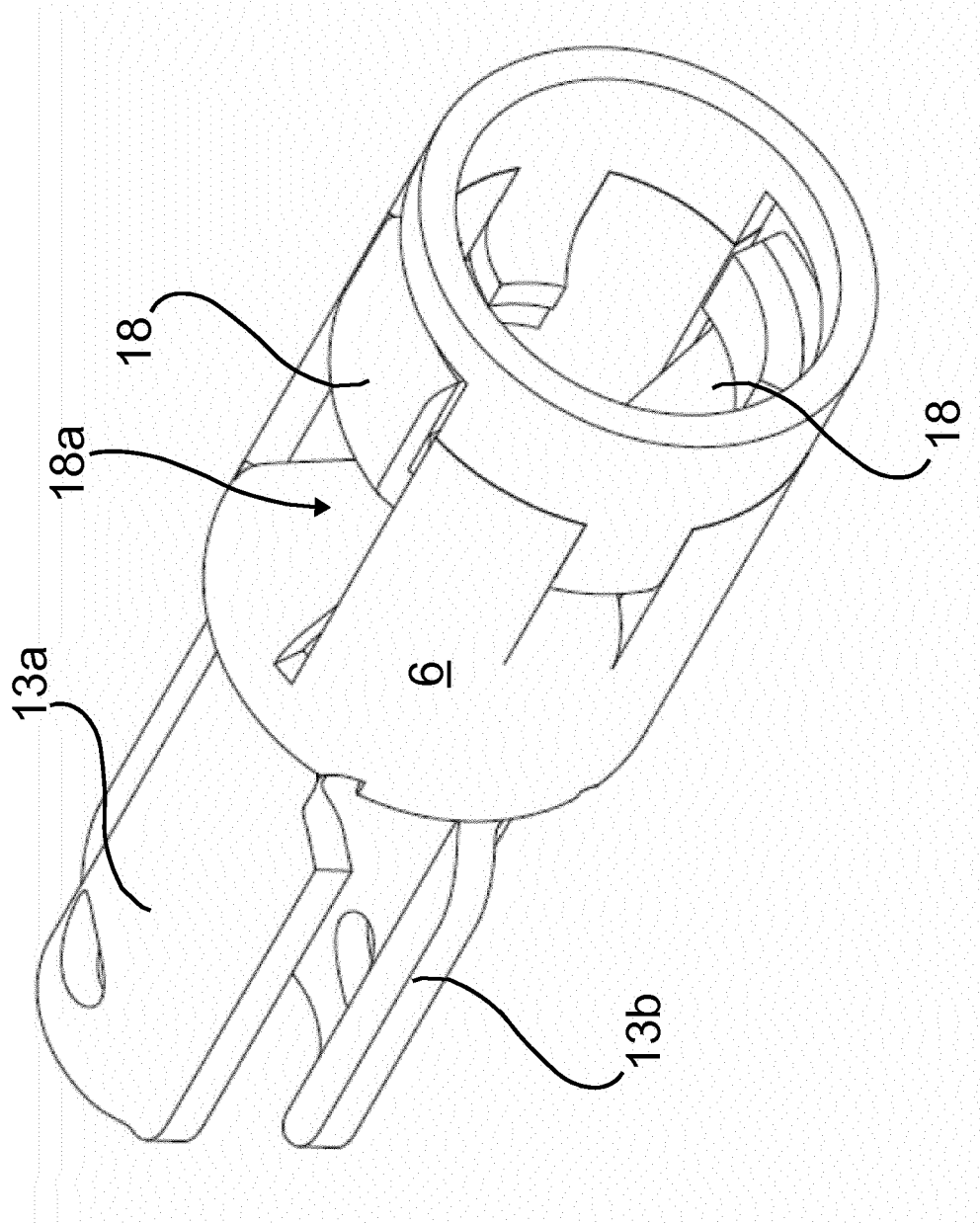


Fig. 6

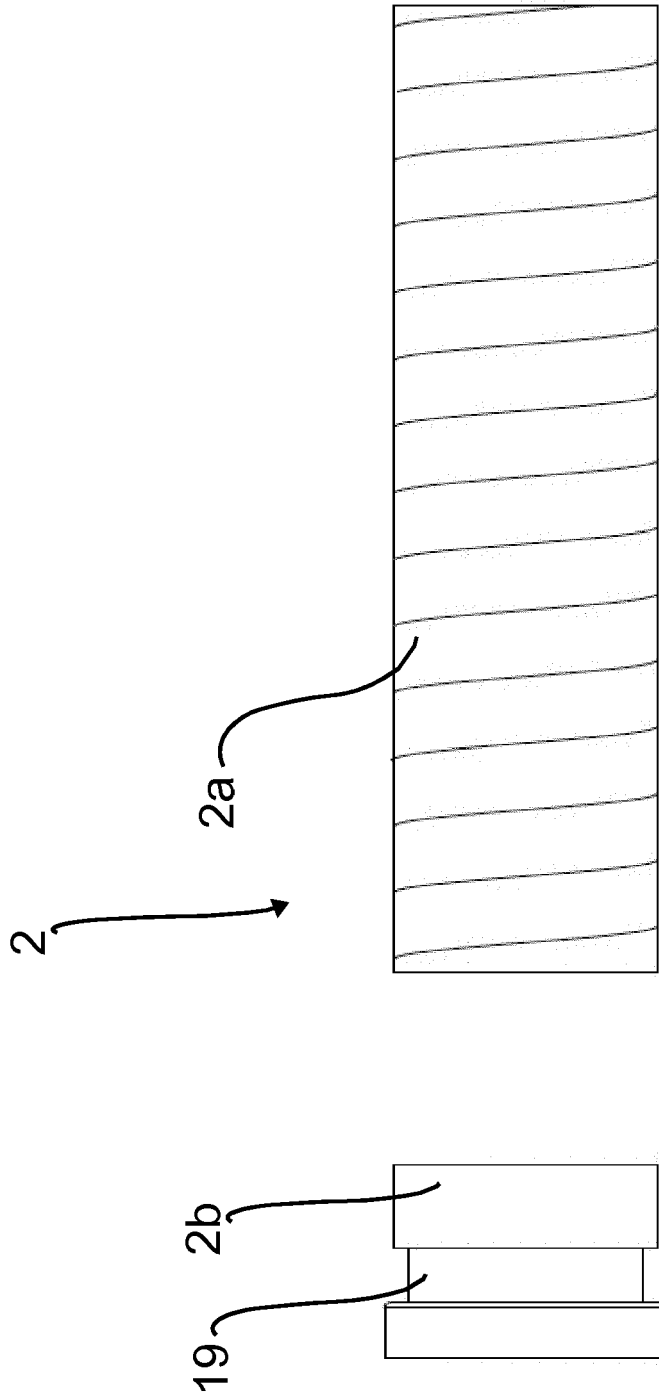


Fig. 7

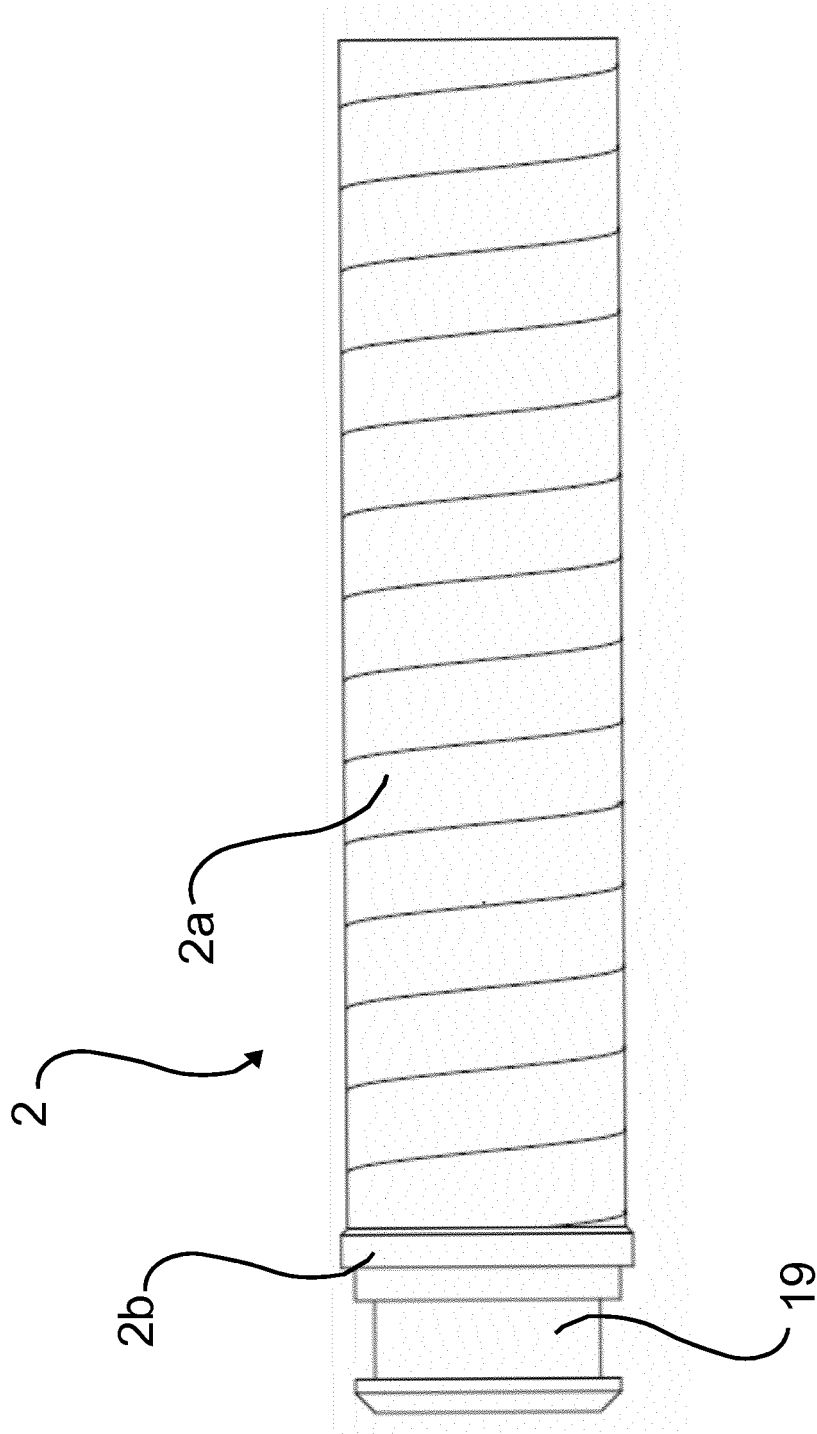


Fig. 8

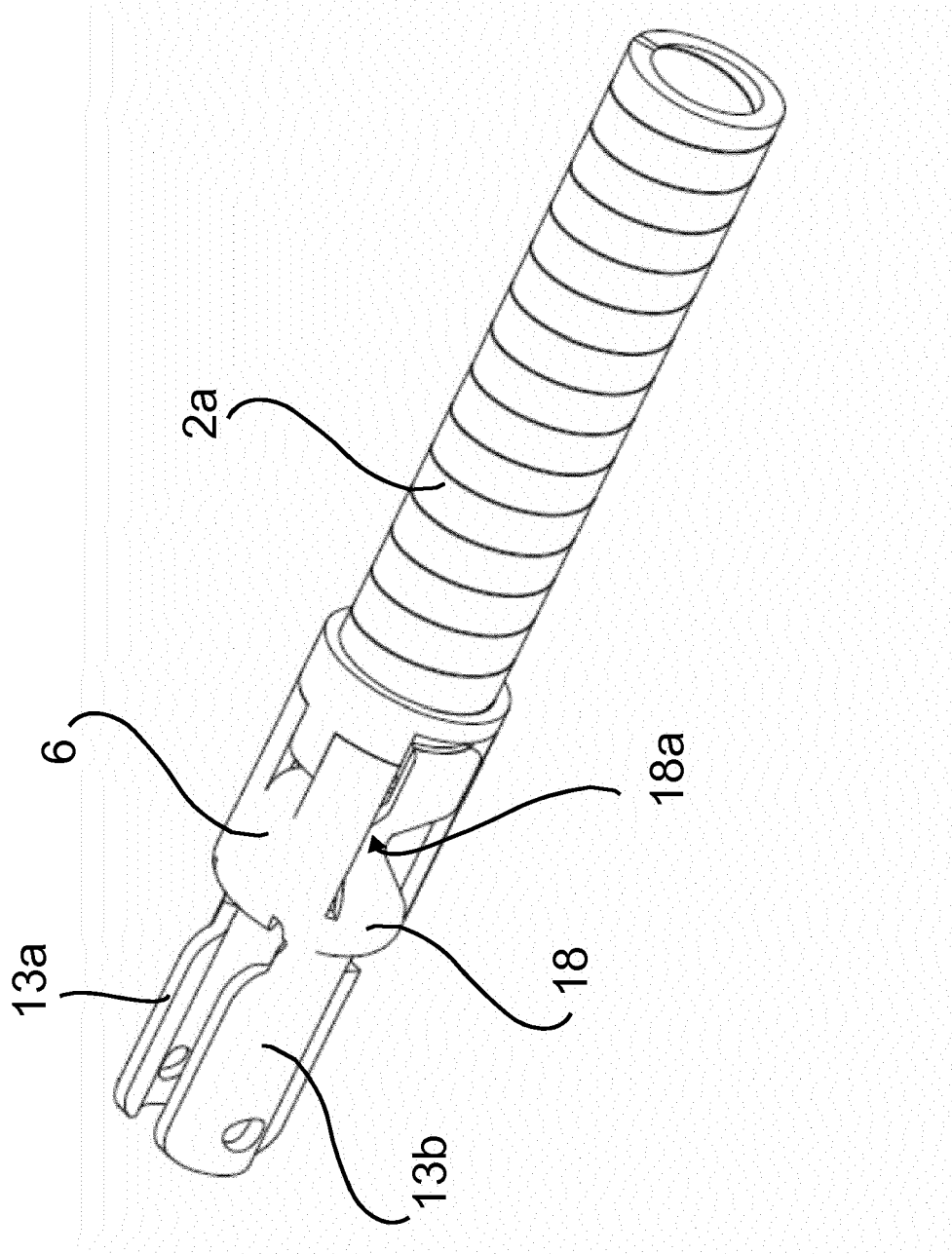


Fig. 9

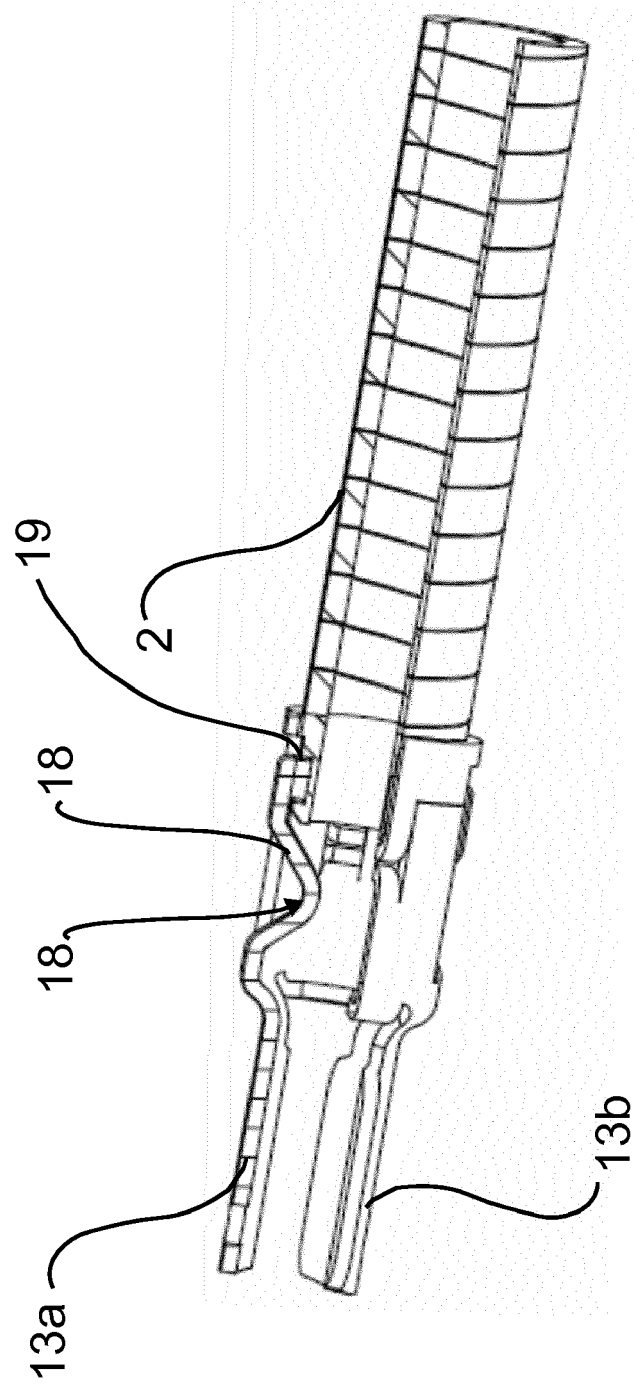


Fig. 10

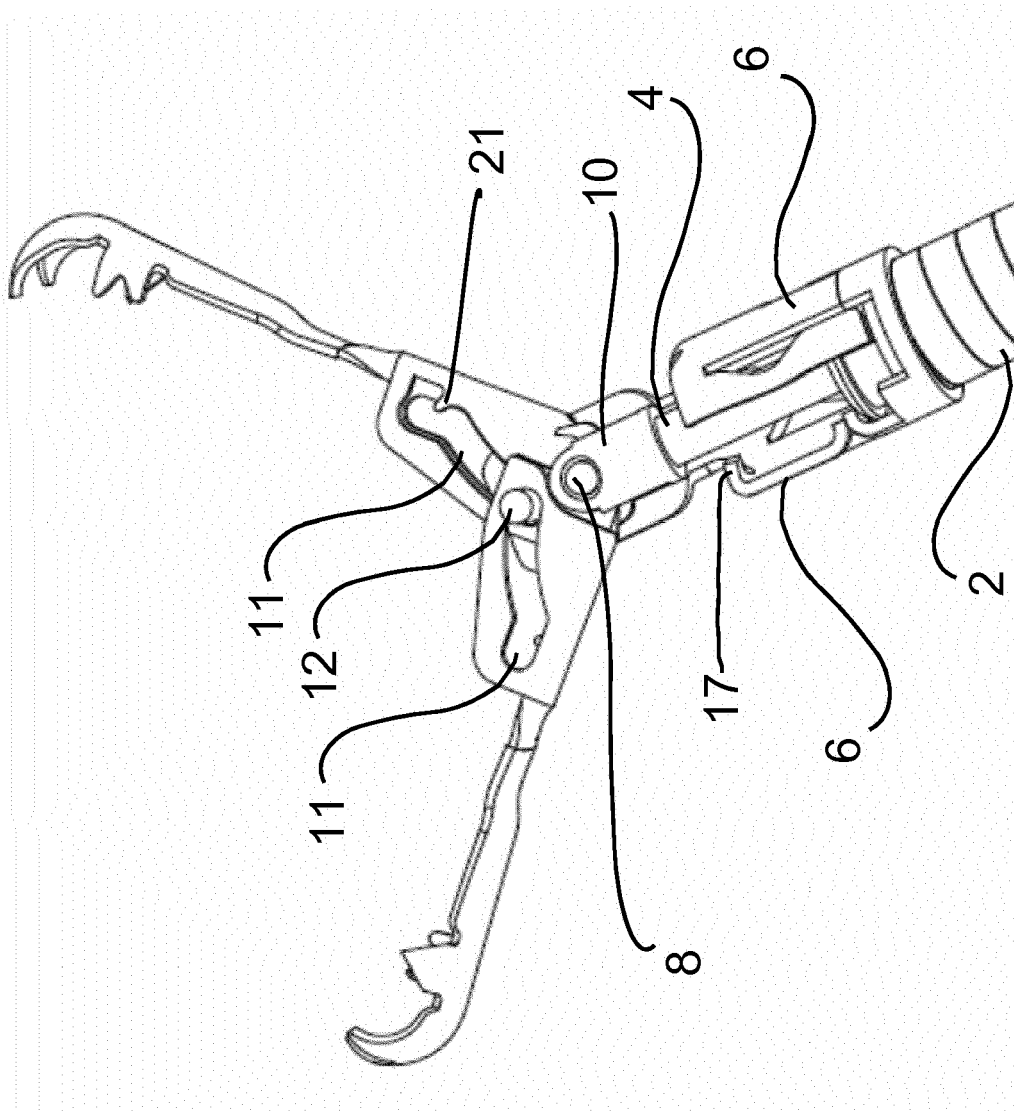


Fig. 11

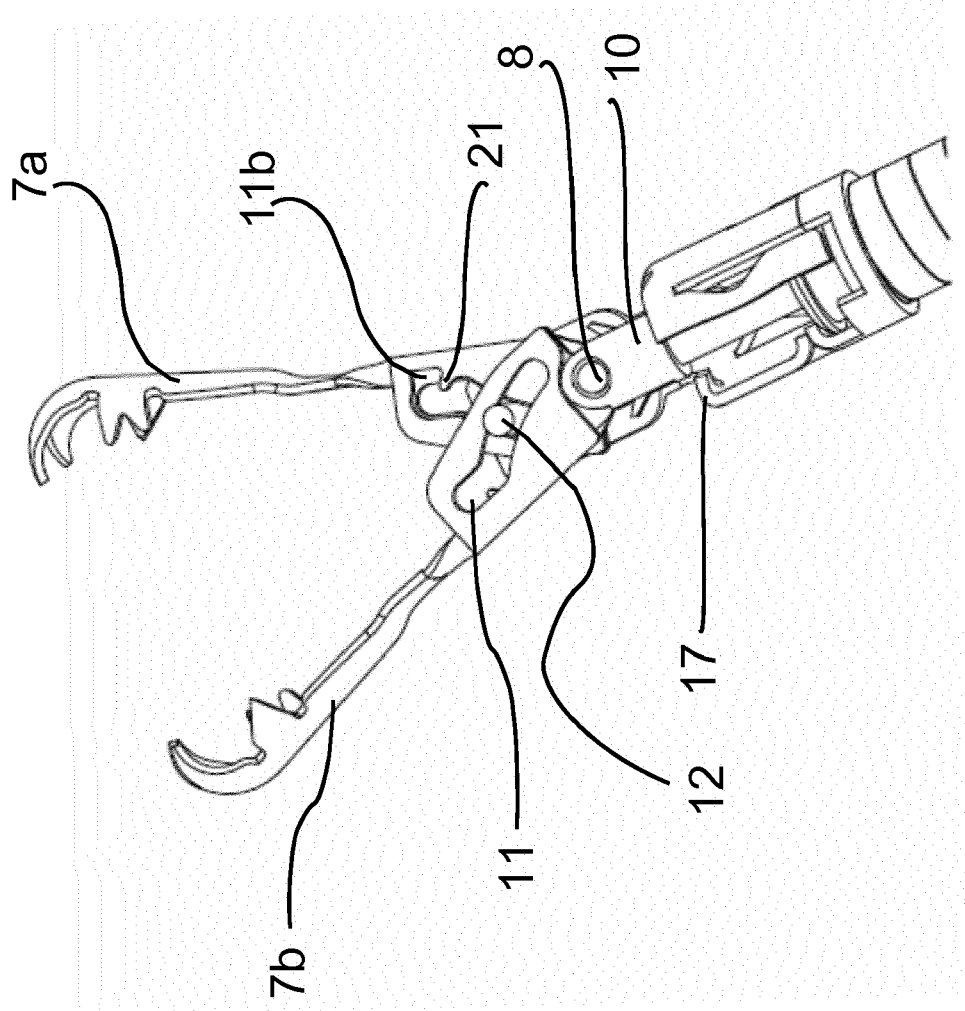


Fig. 12

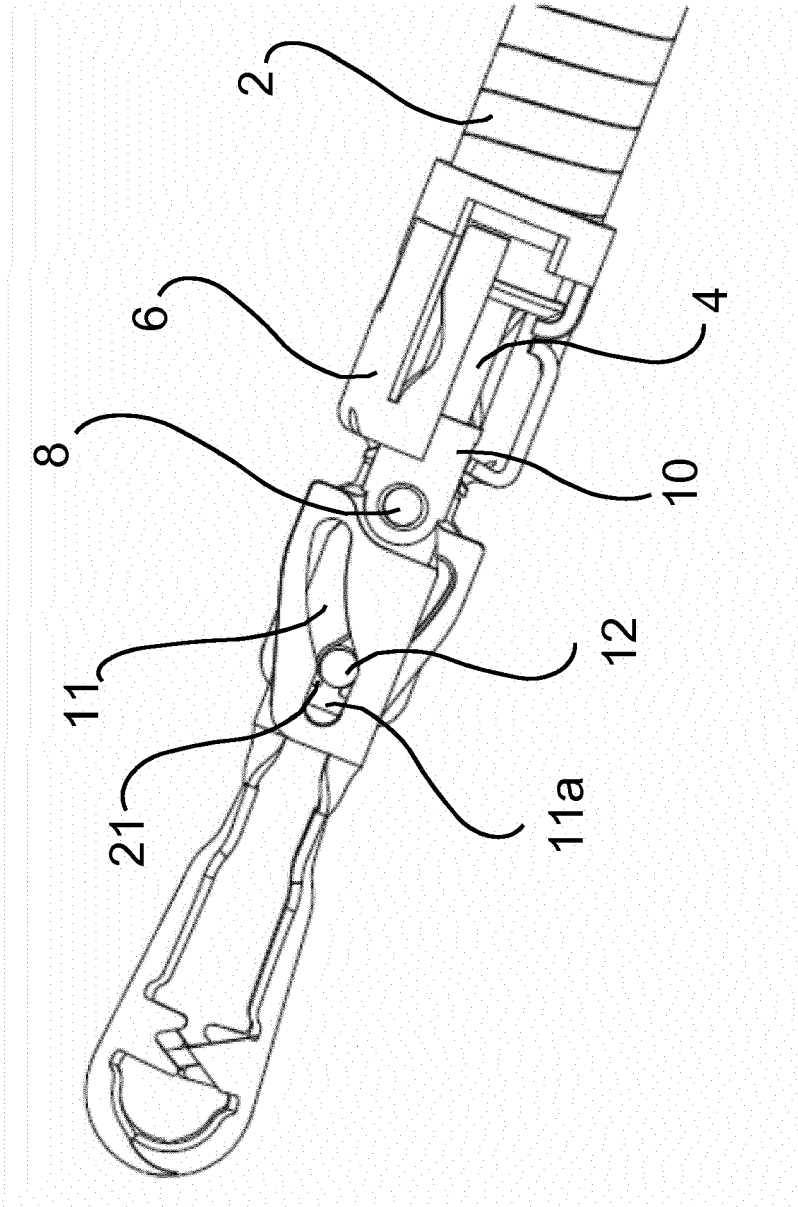


Fig. 13

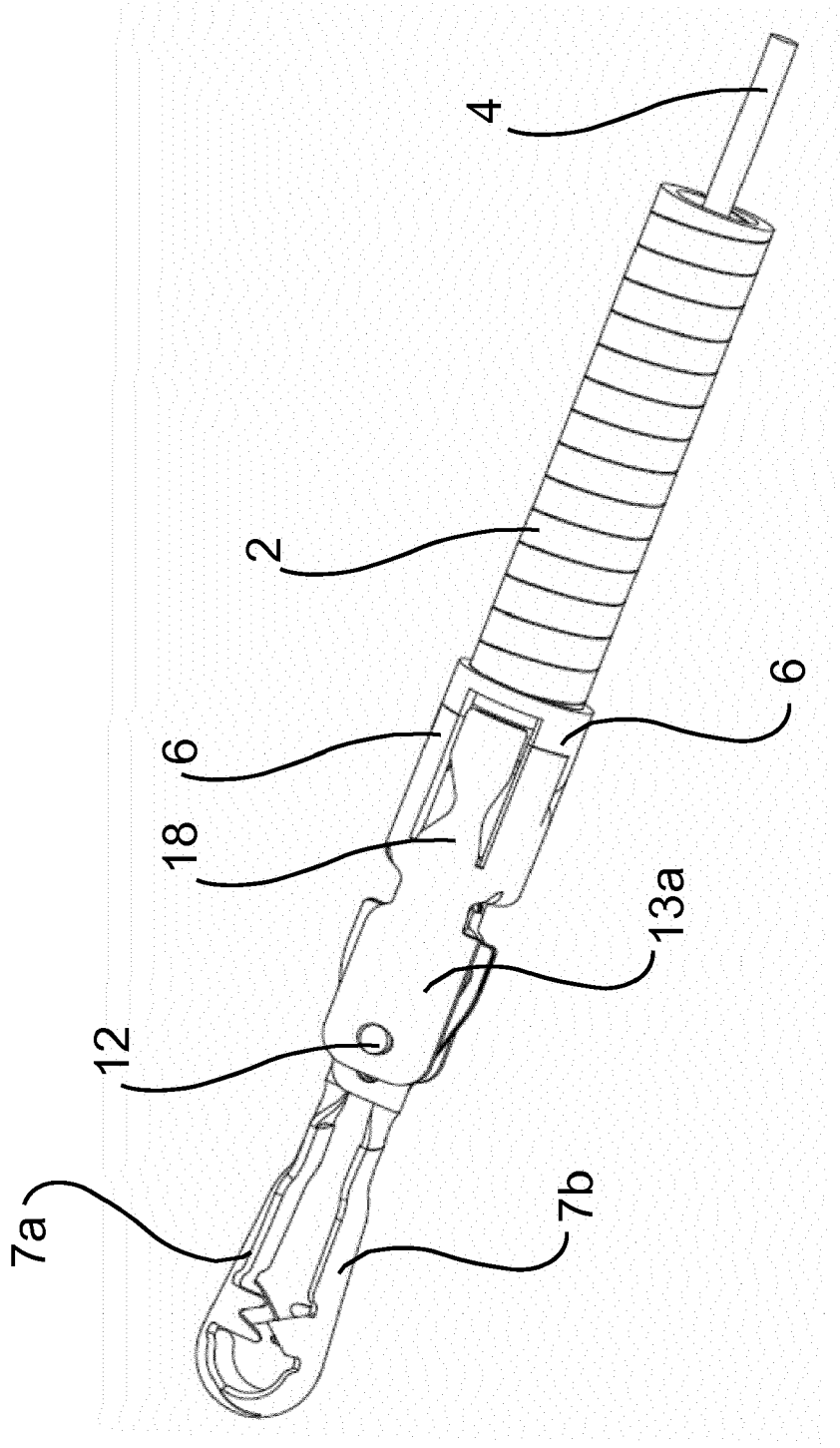


Fig. 14

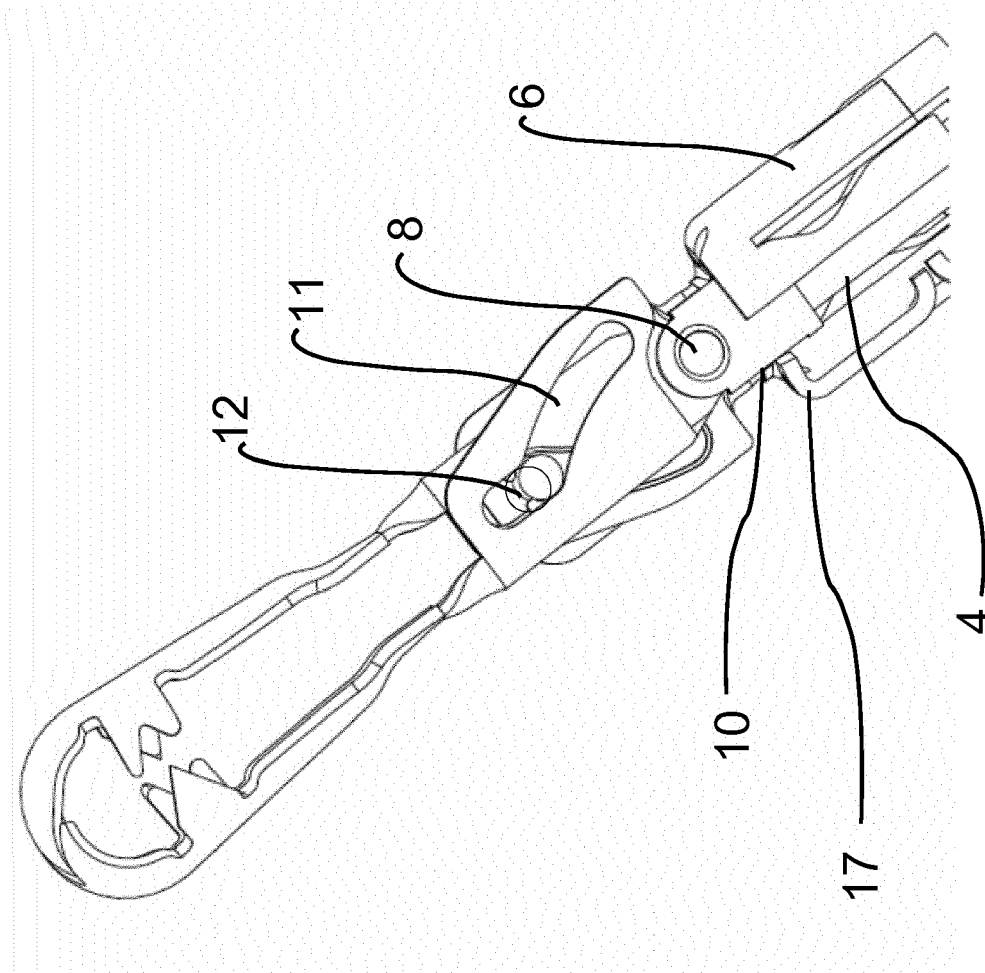


Fig. 15

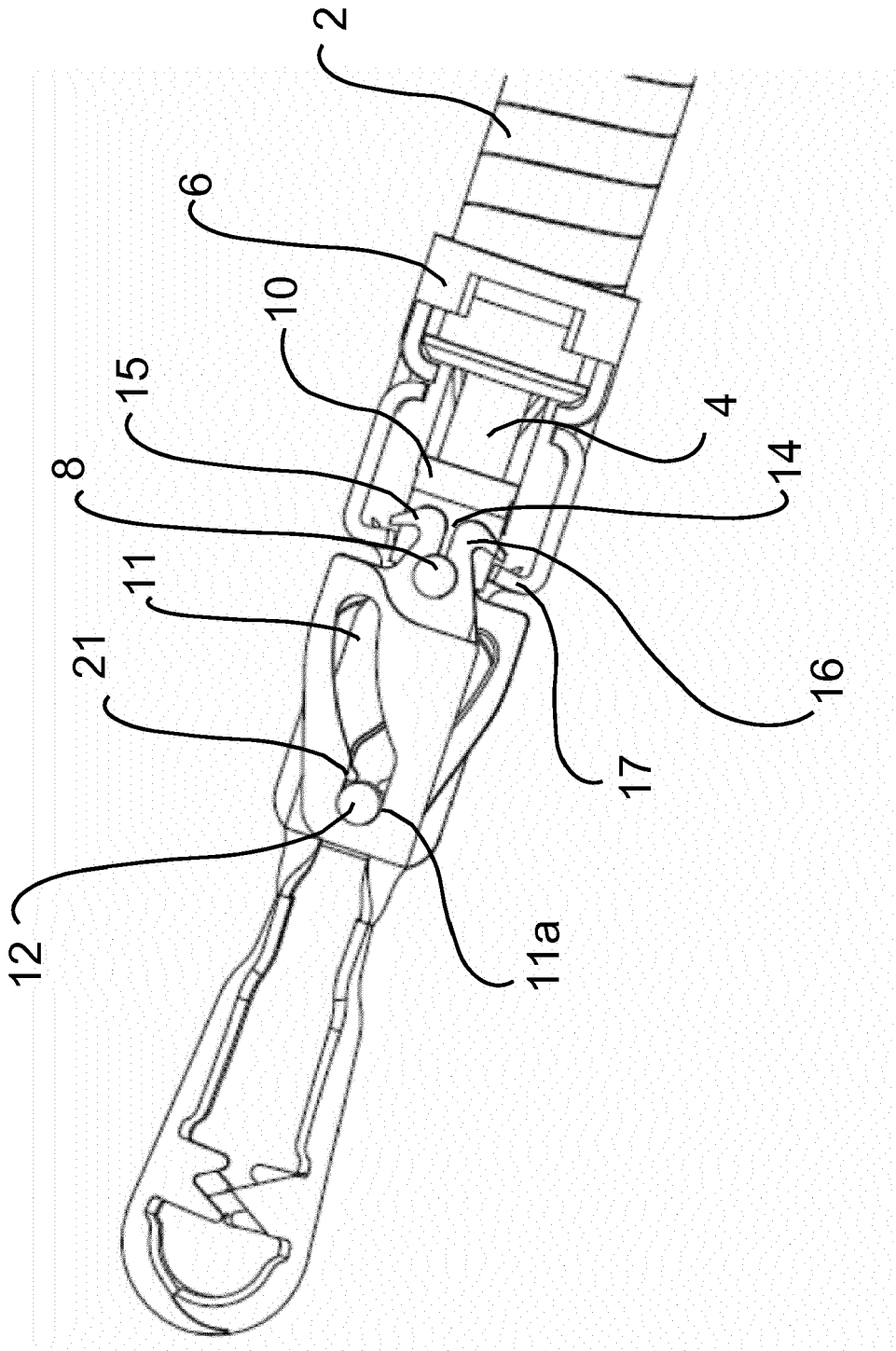


Fig. 16

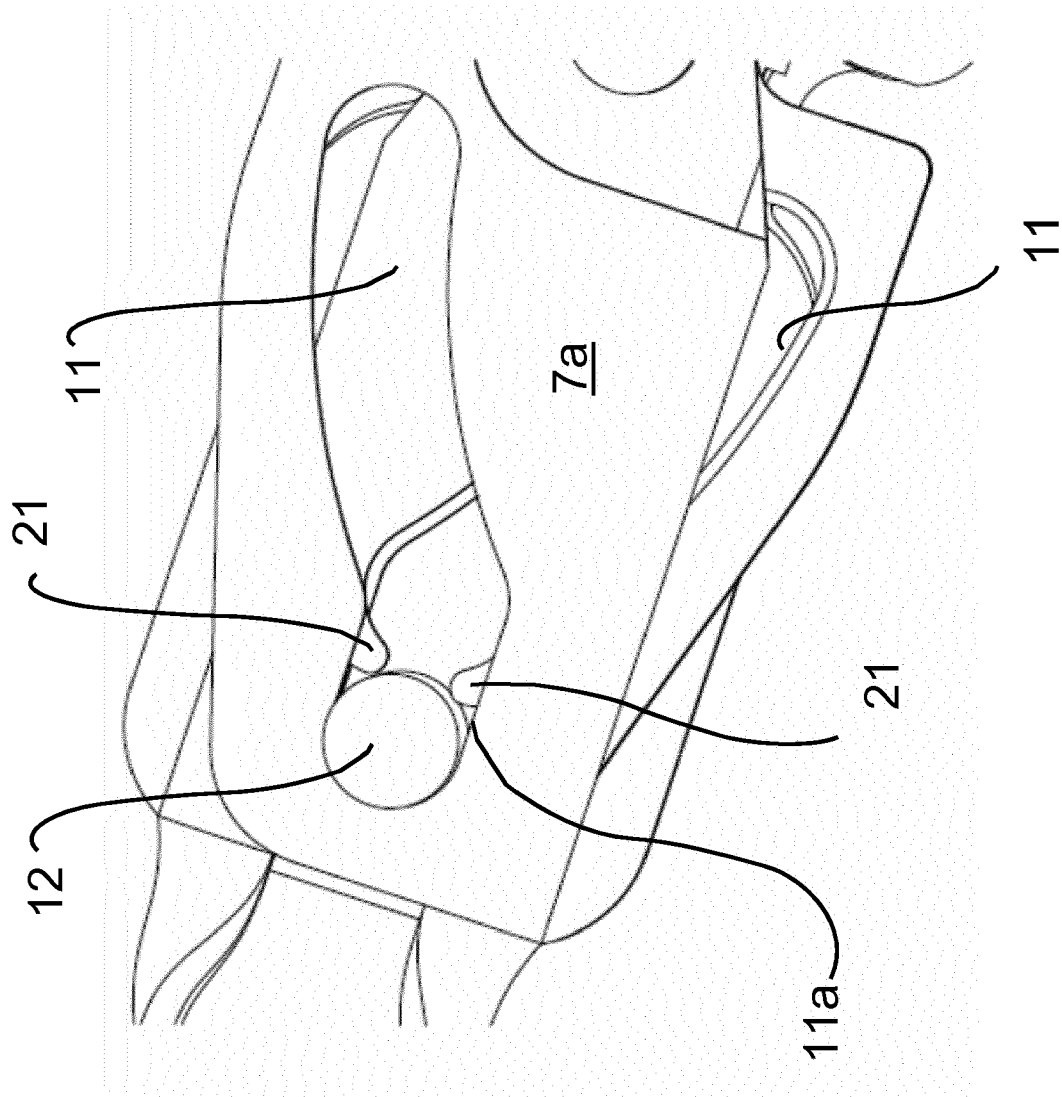


Fig. 17

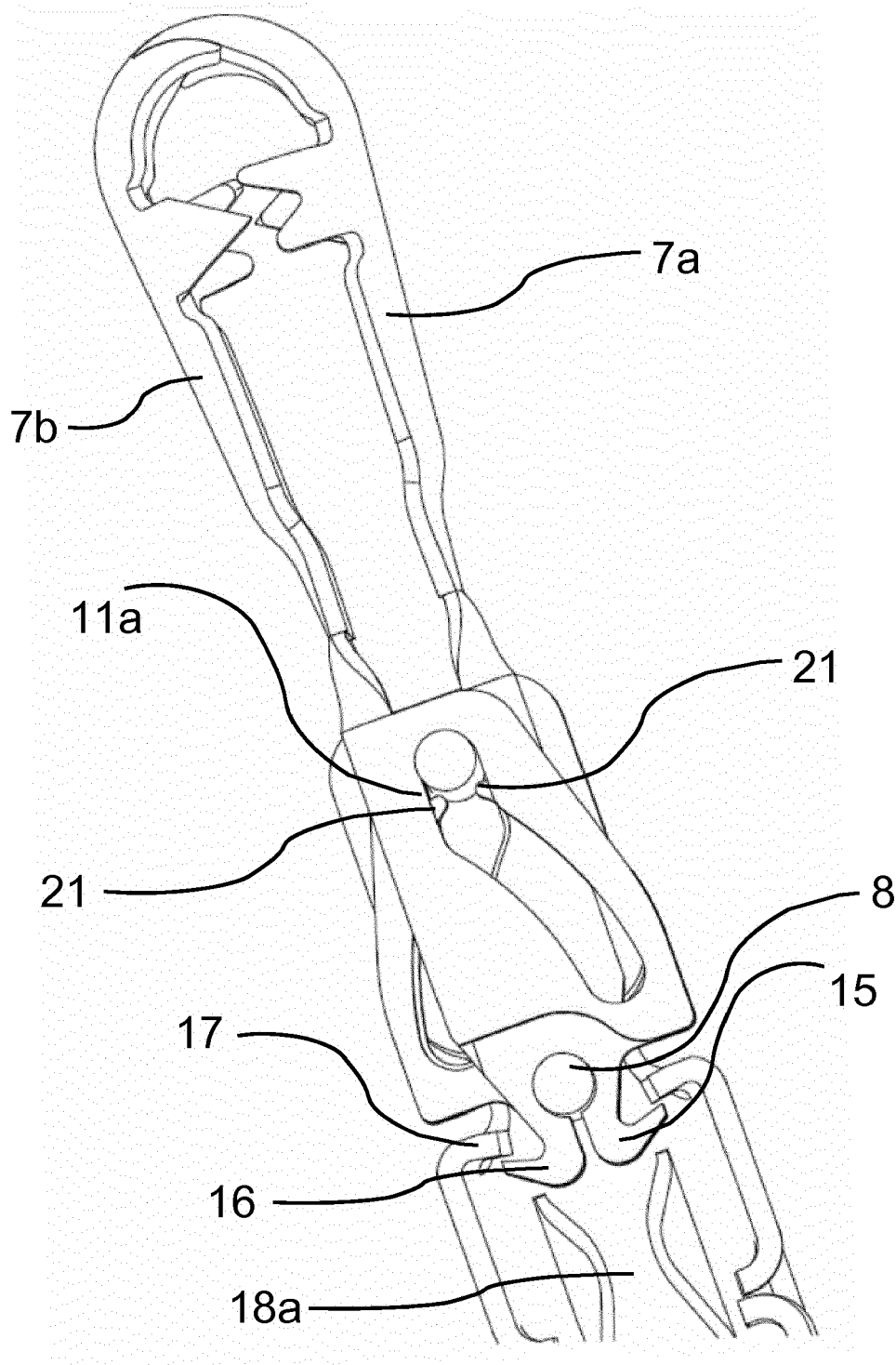


Fig. 18

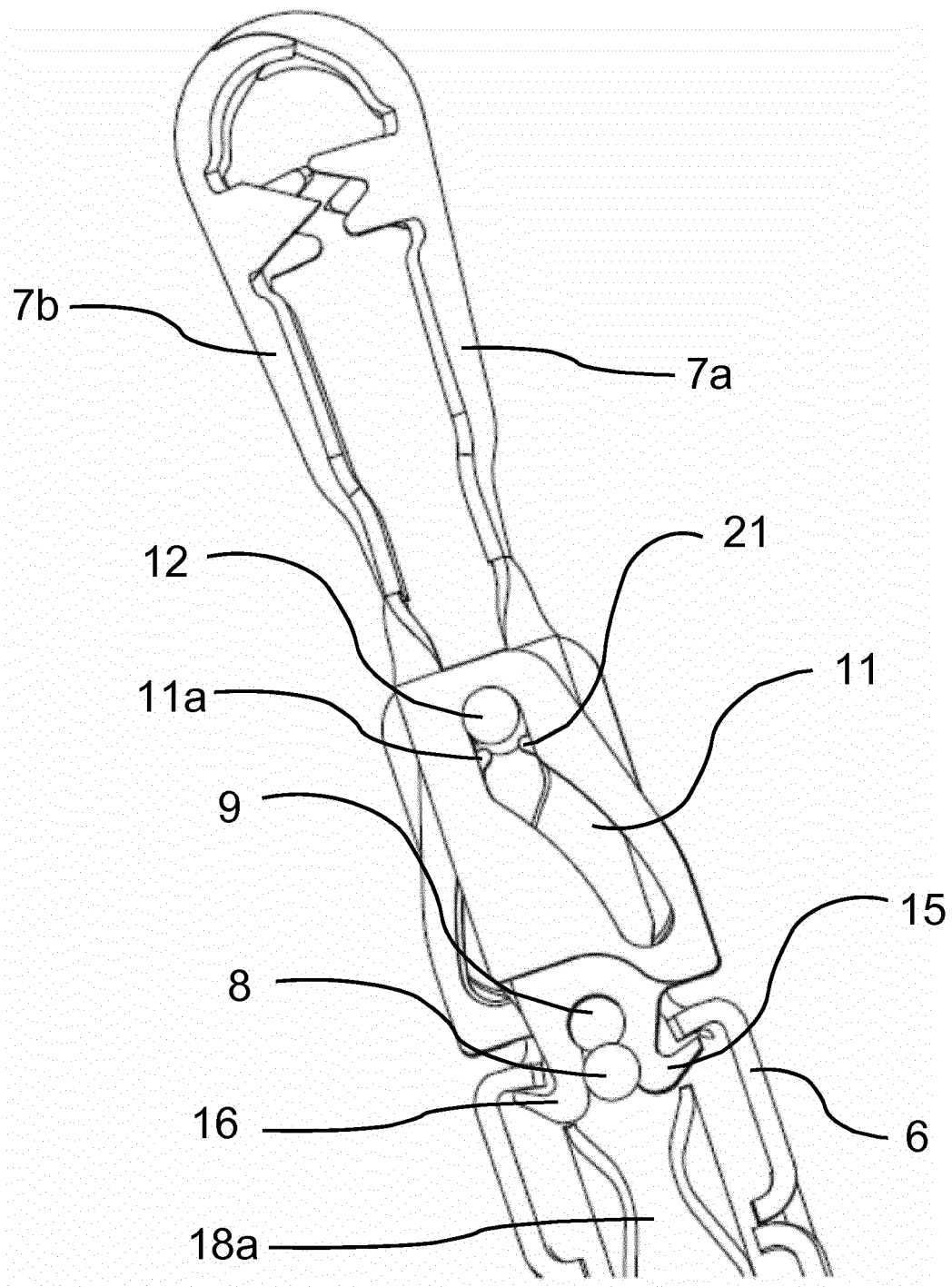


Fig. 19

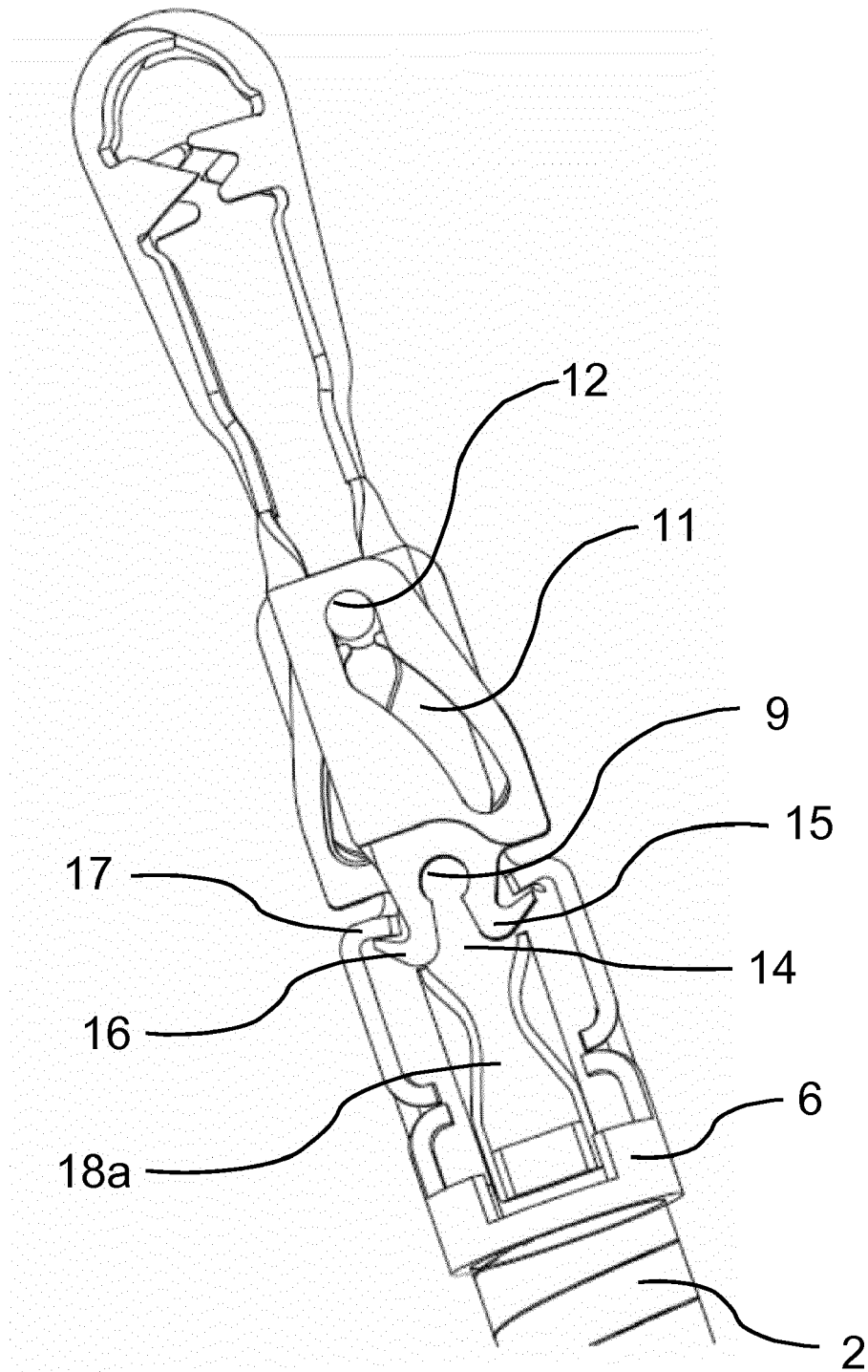


Fig. 20

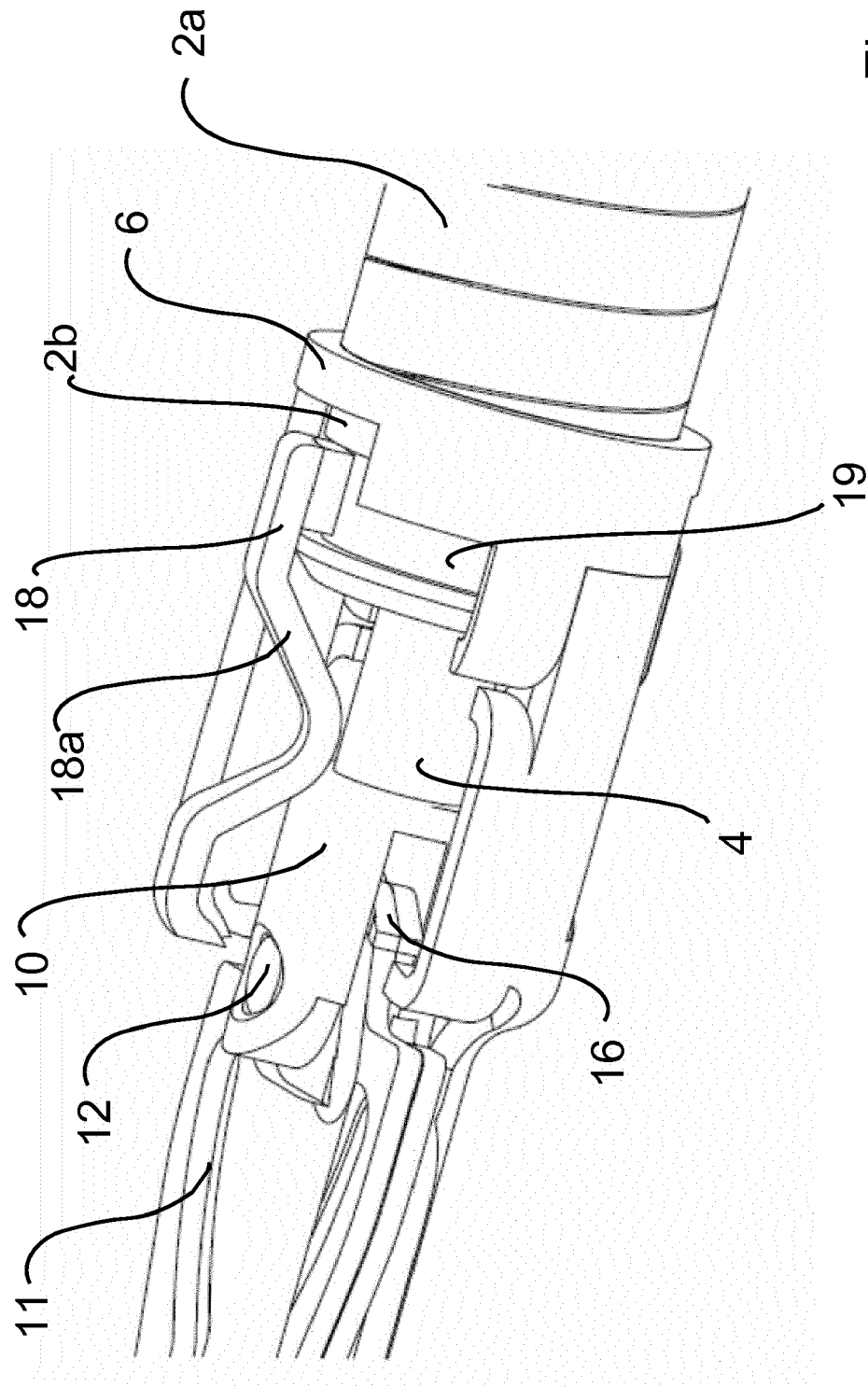


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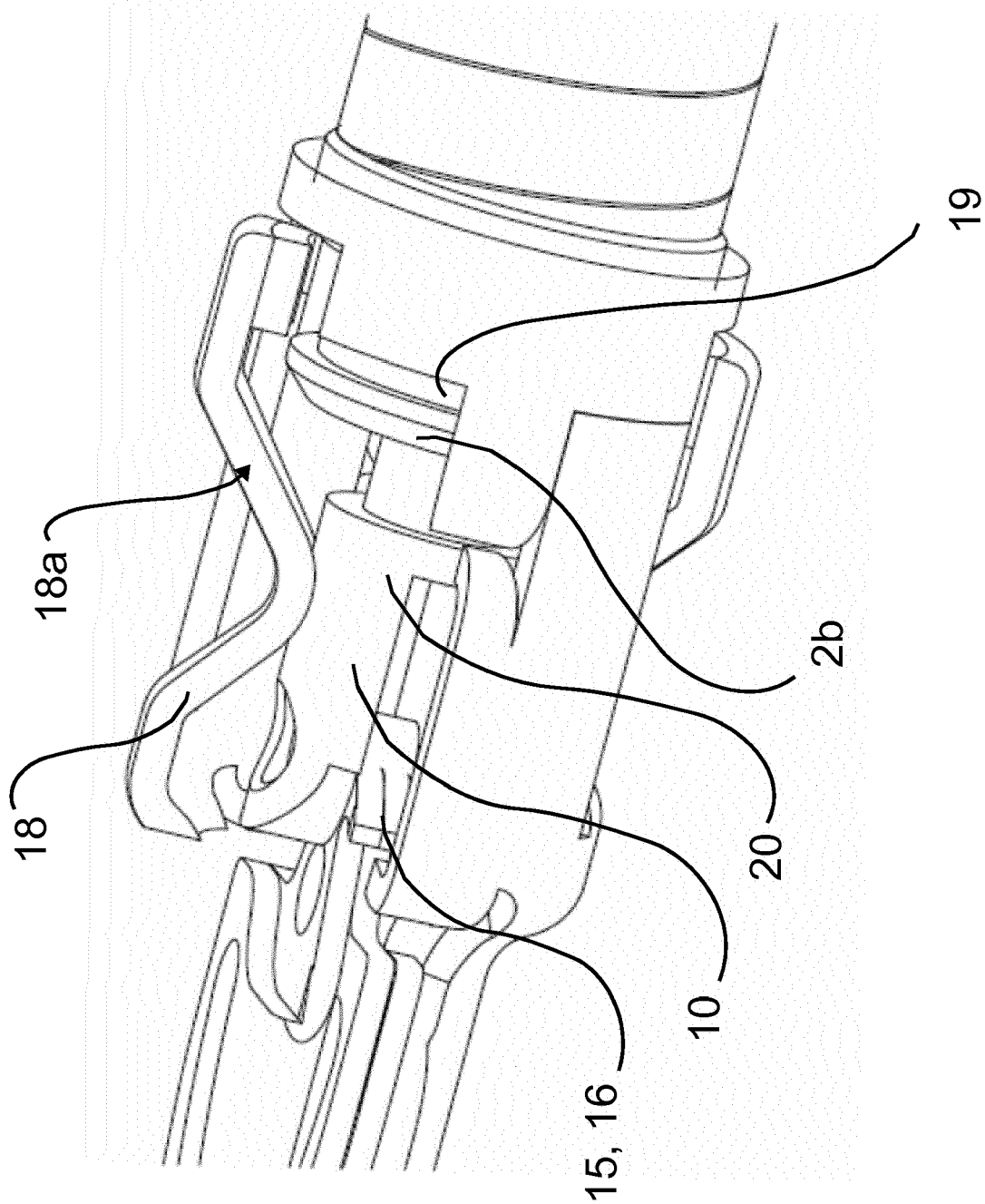


Fig. 22

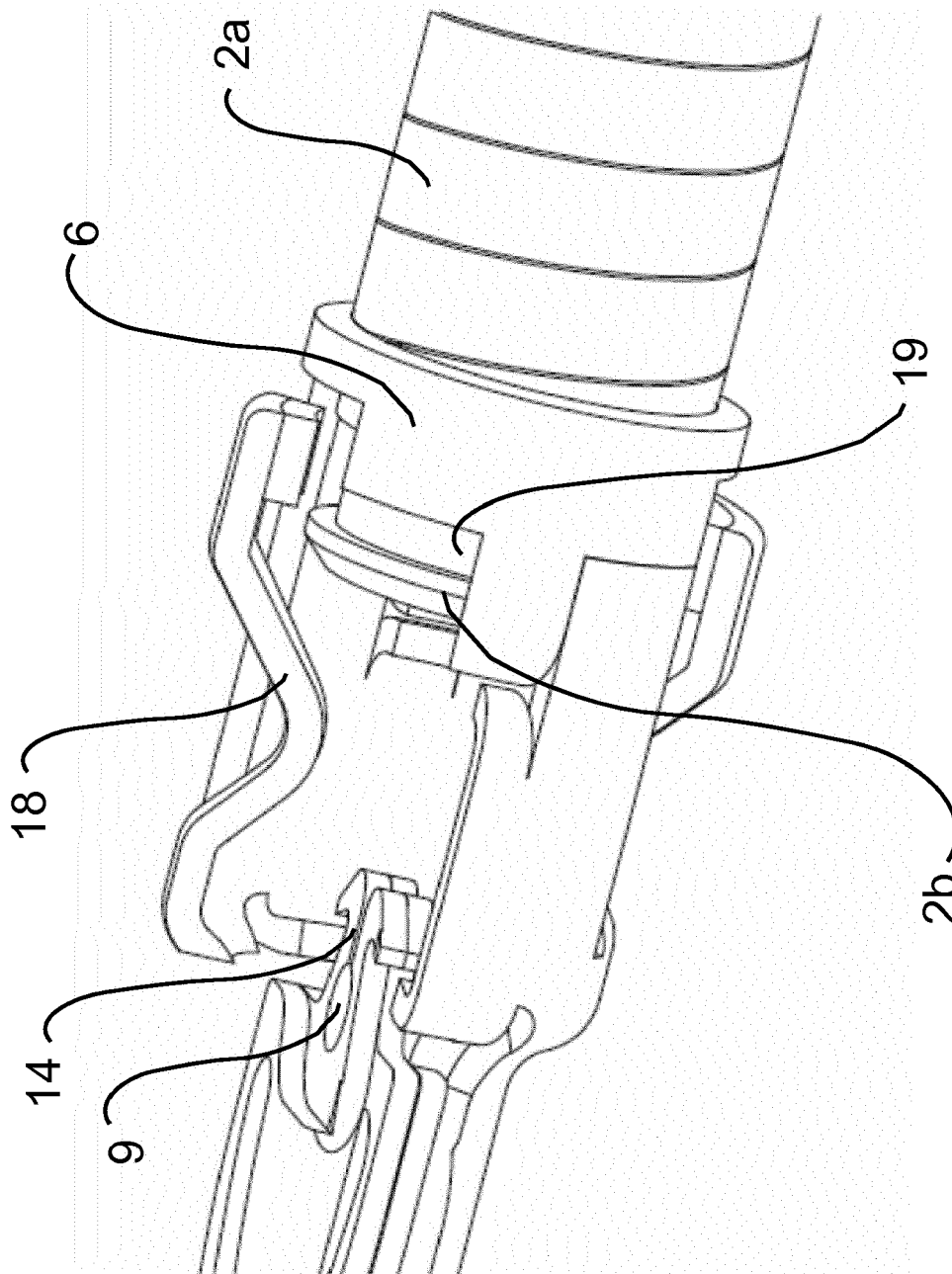


Fig. 23

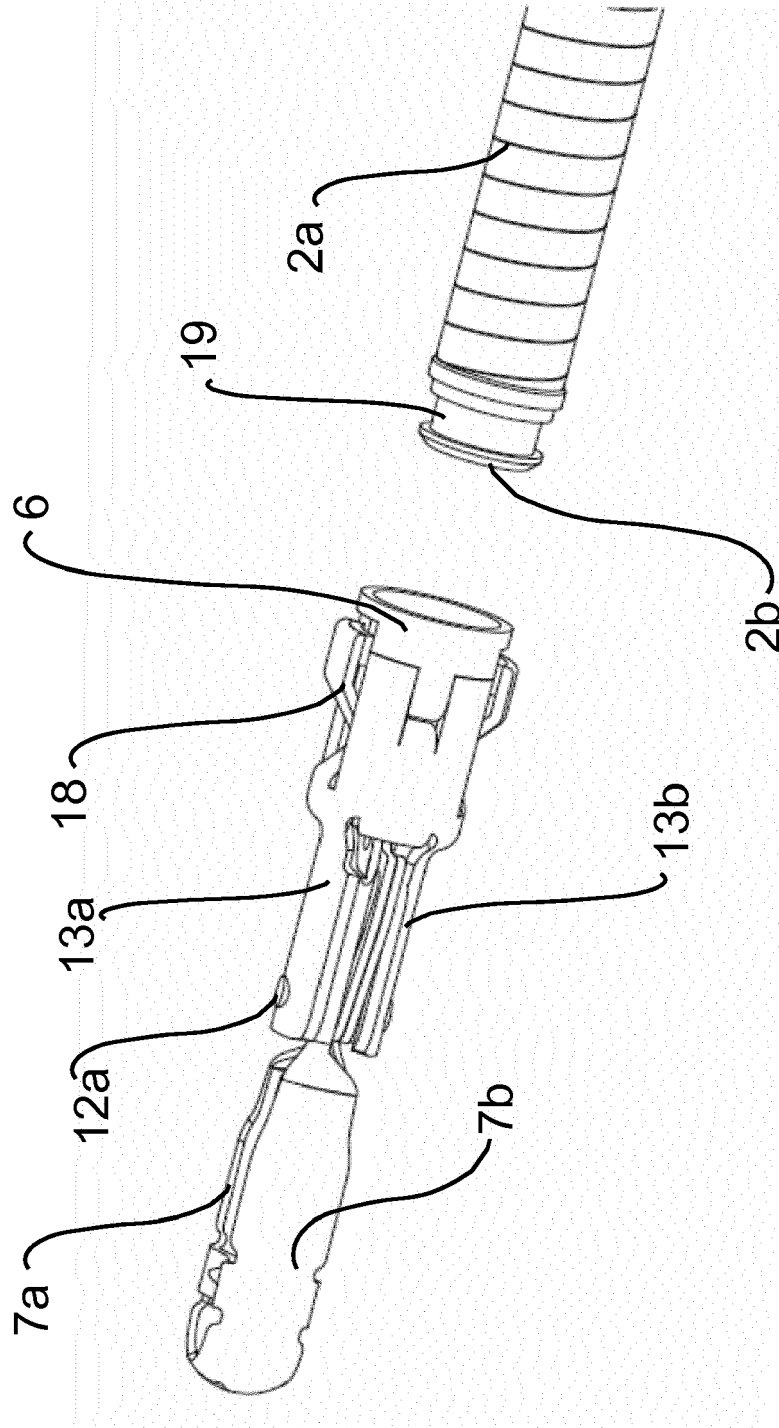


Fig. 24

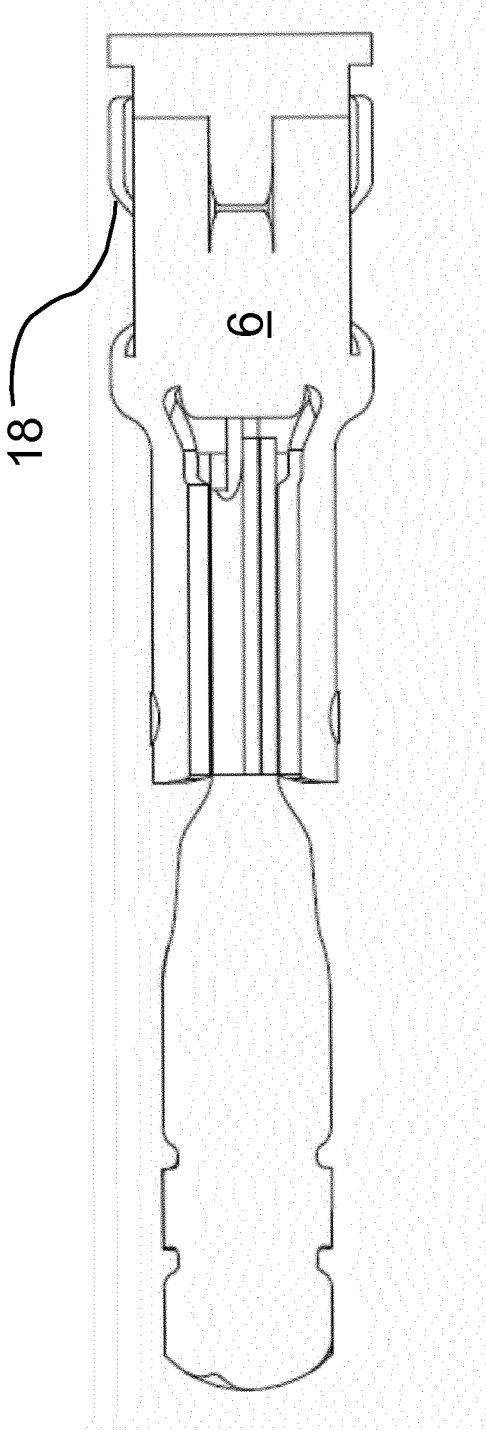


Fig. 25

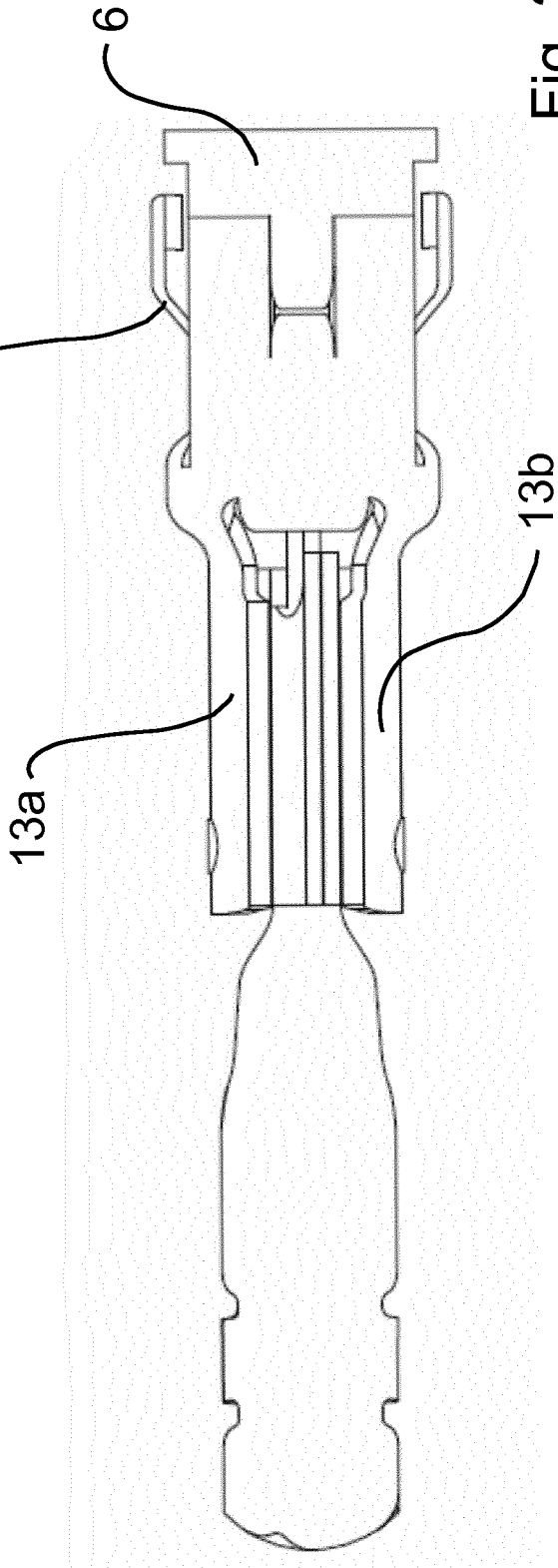


Fig. 26

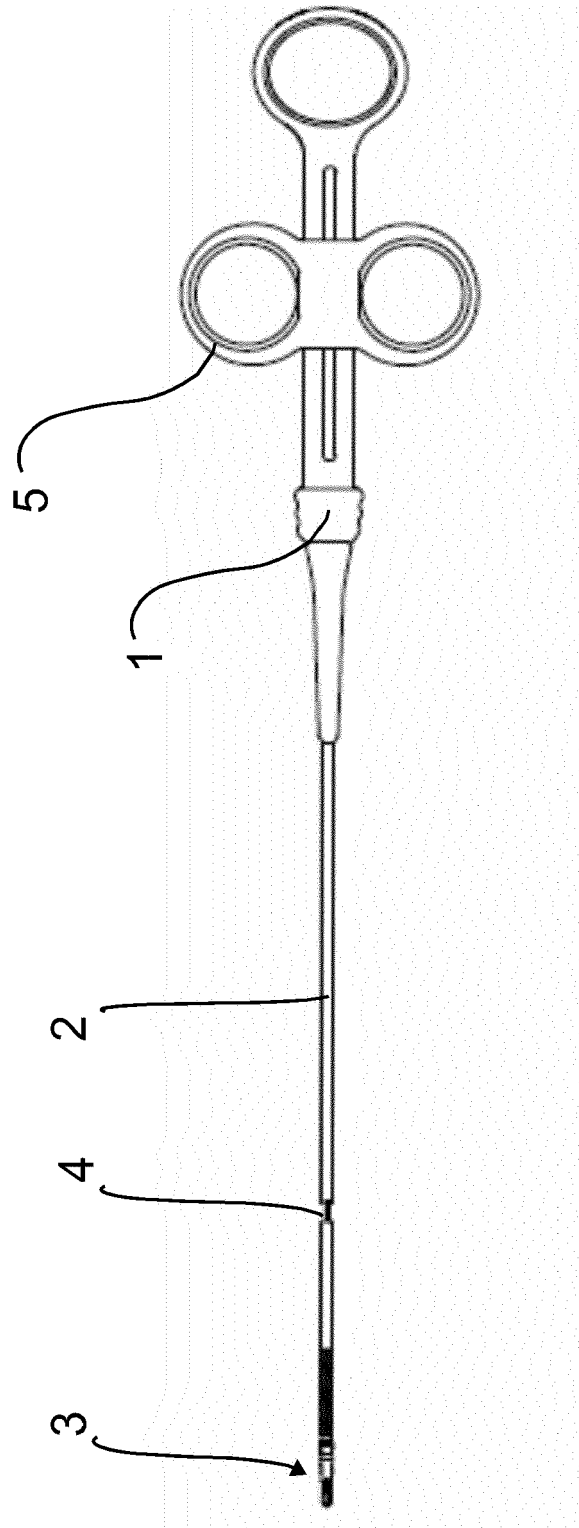


Fig. 27

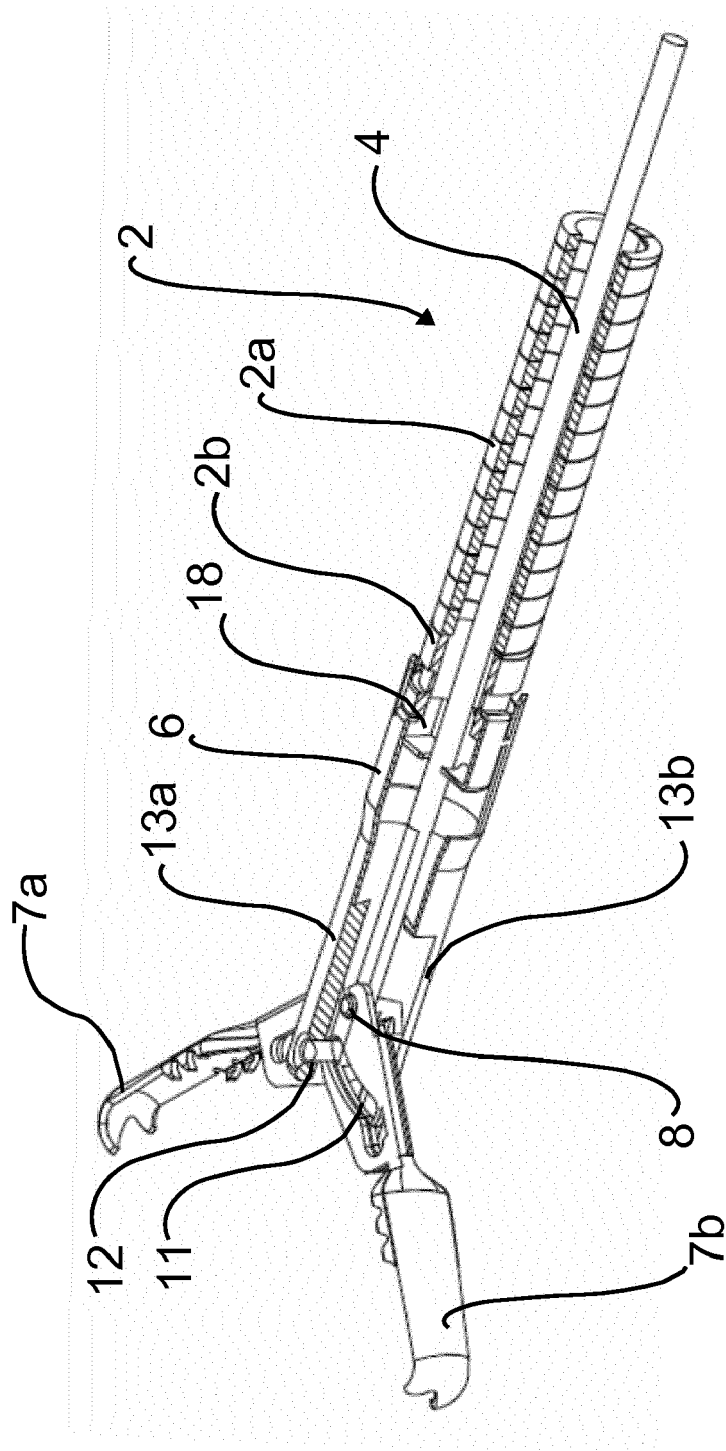


Fig. 28

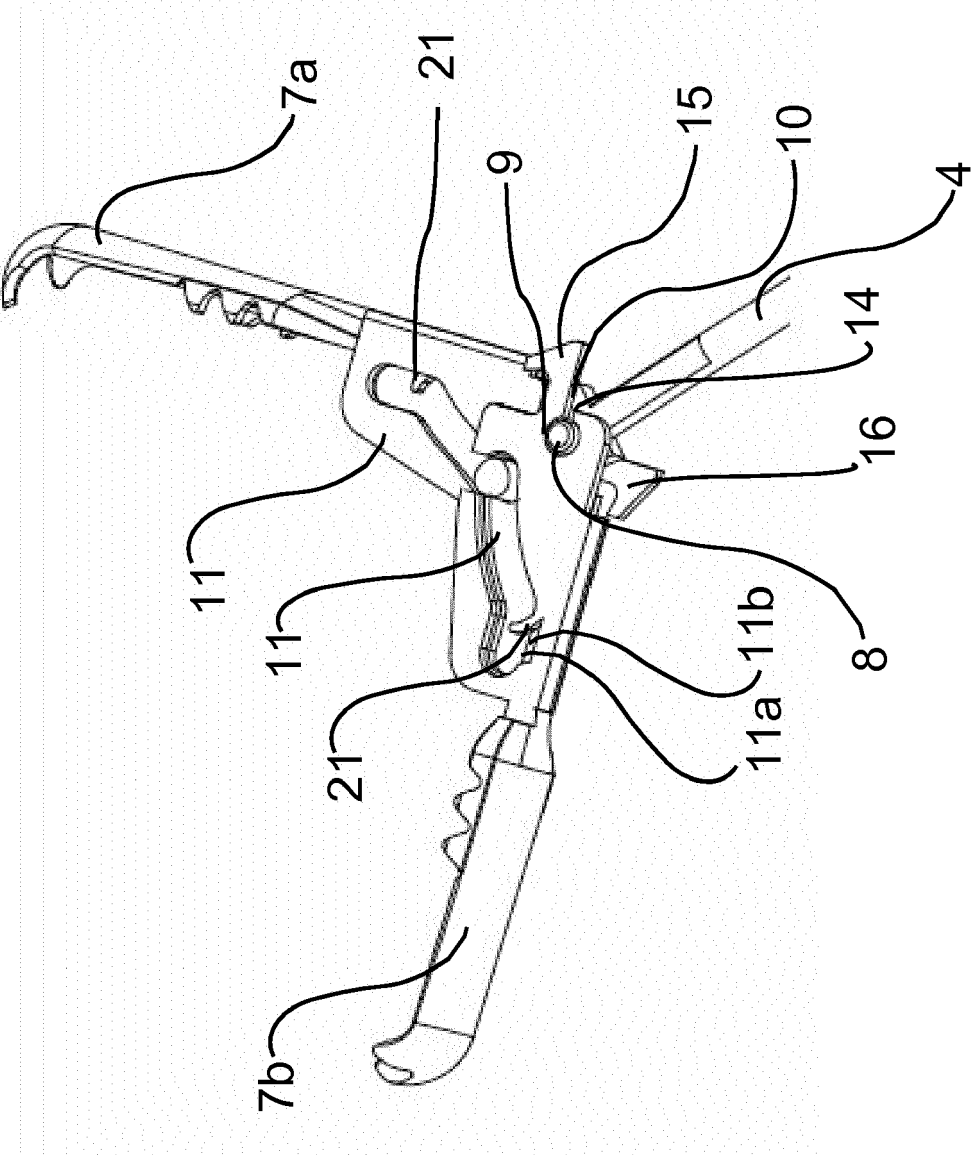


Fig. 29

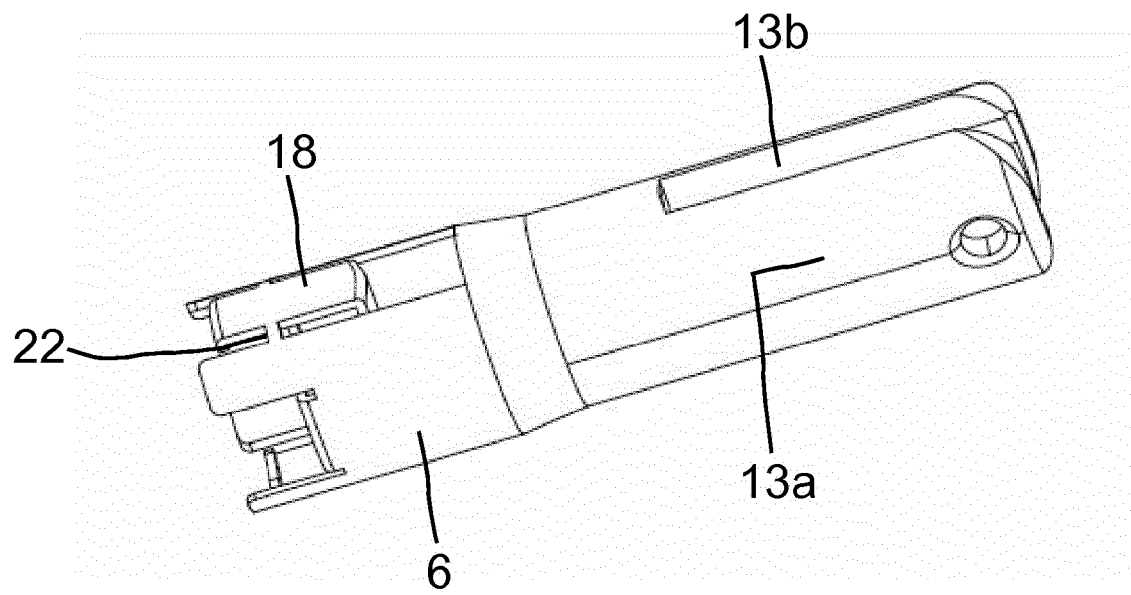


Fig. 30

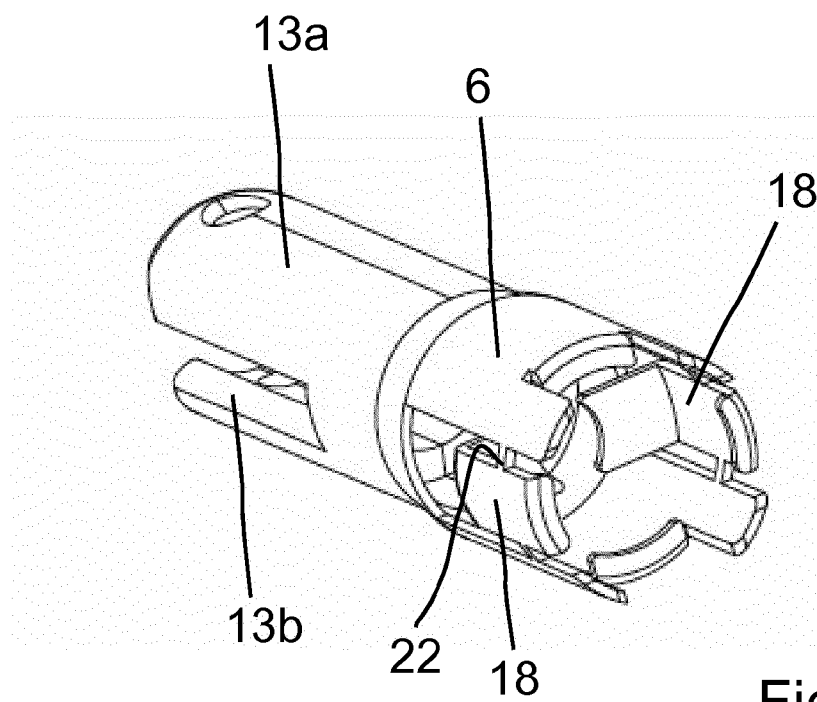


Fig. 31

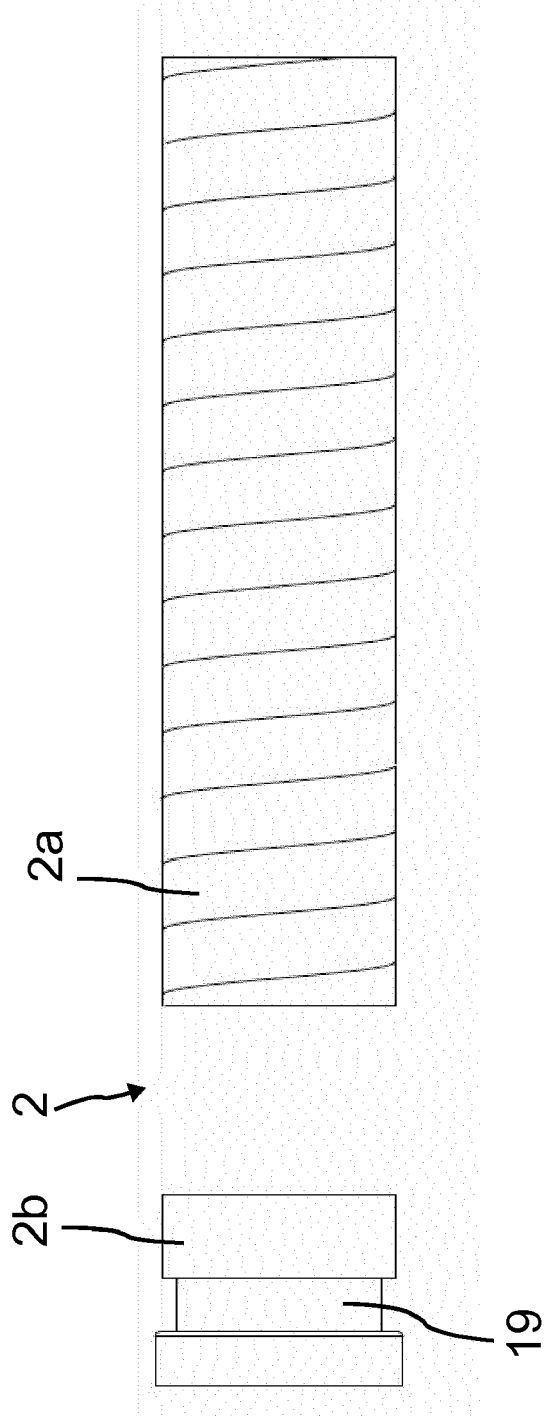


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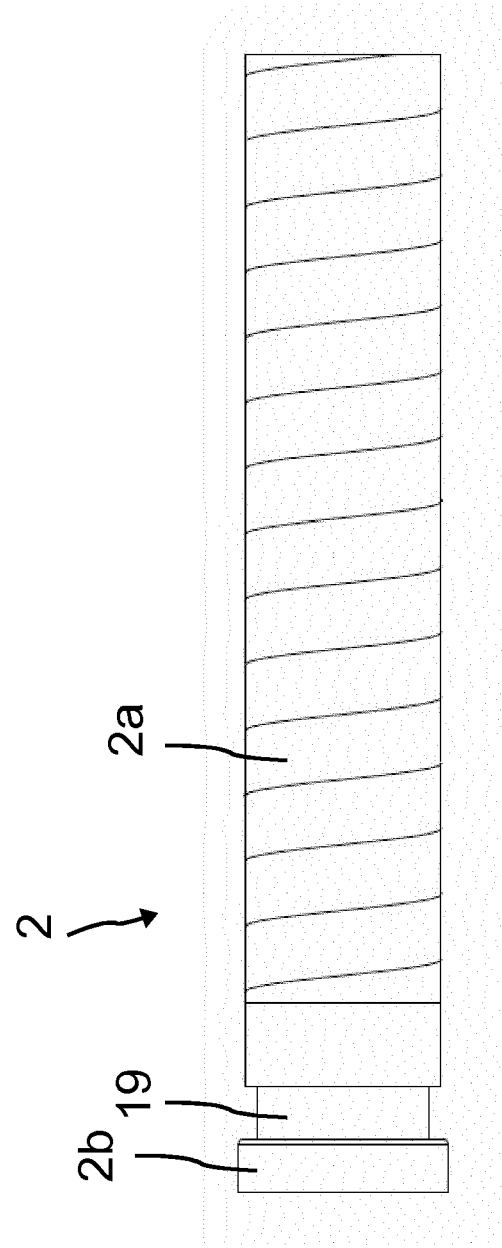


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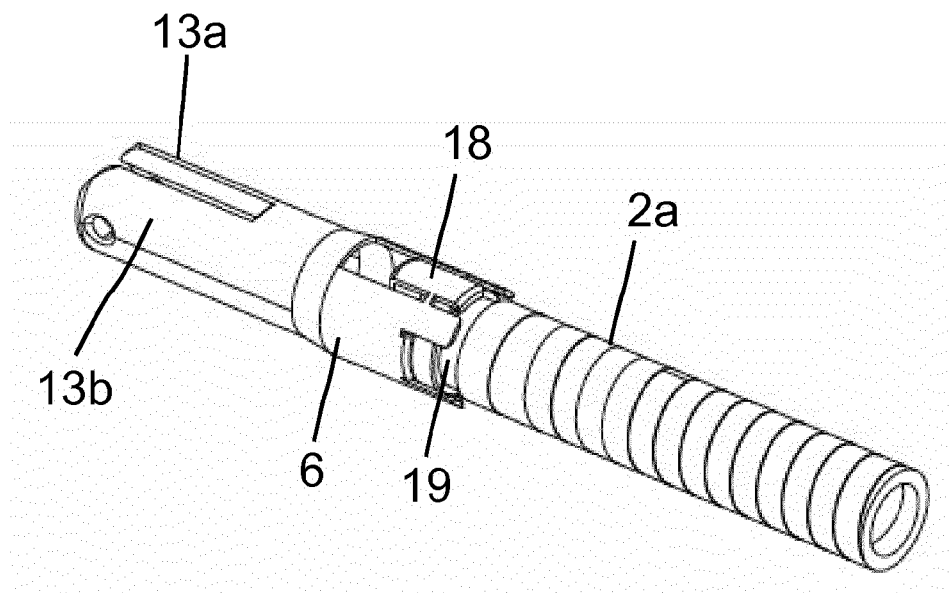


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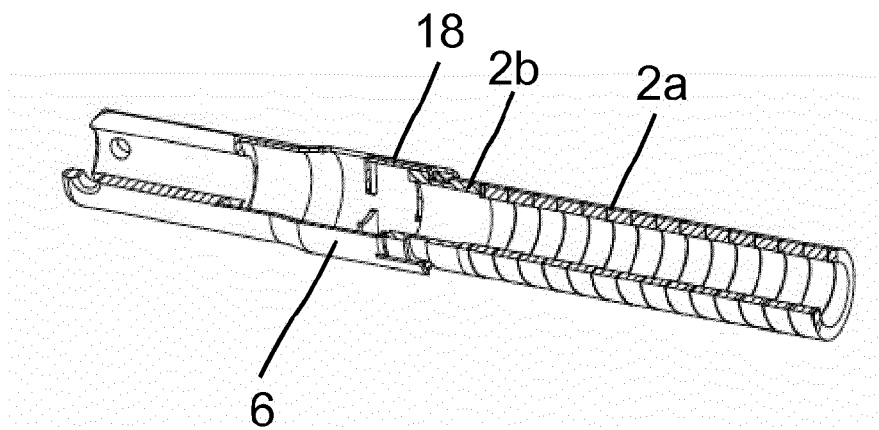


Fig. 35

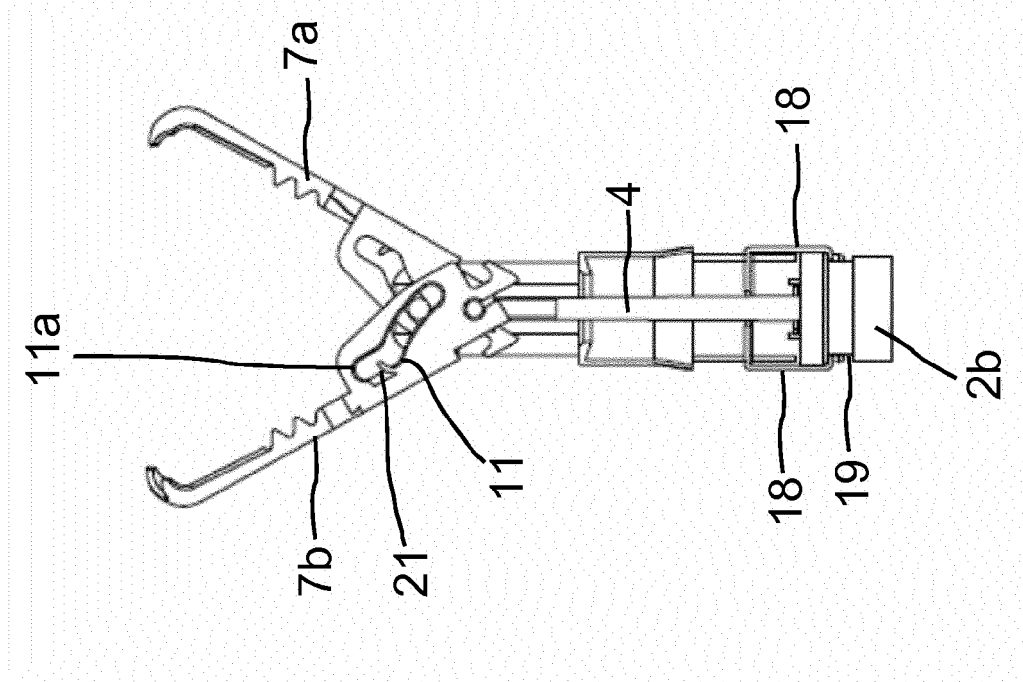


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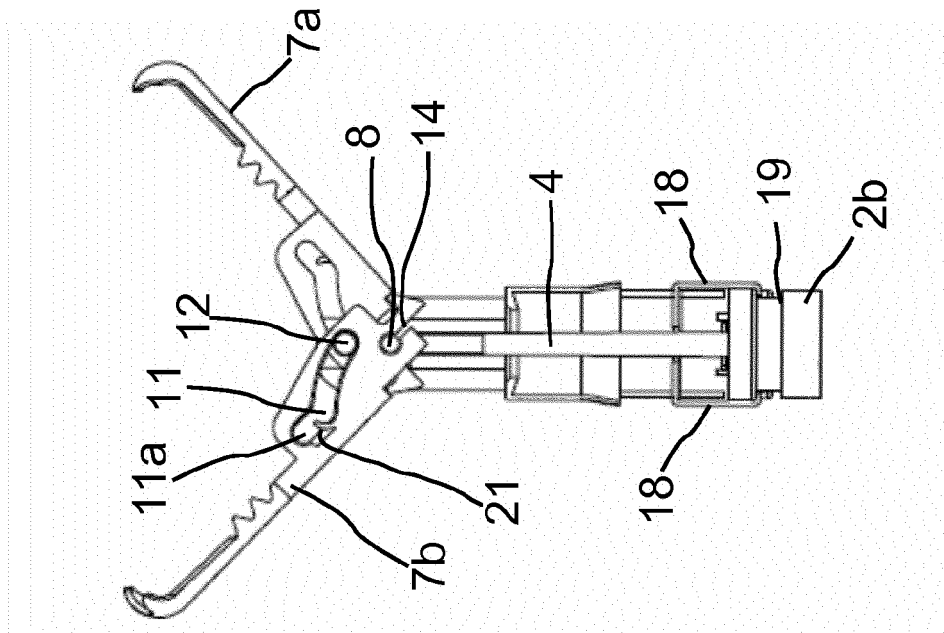


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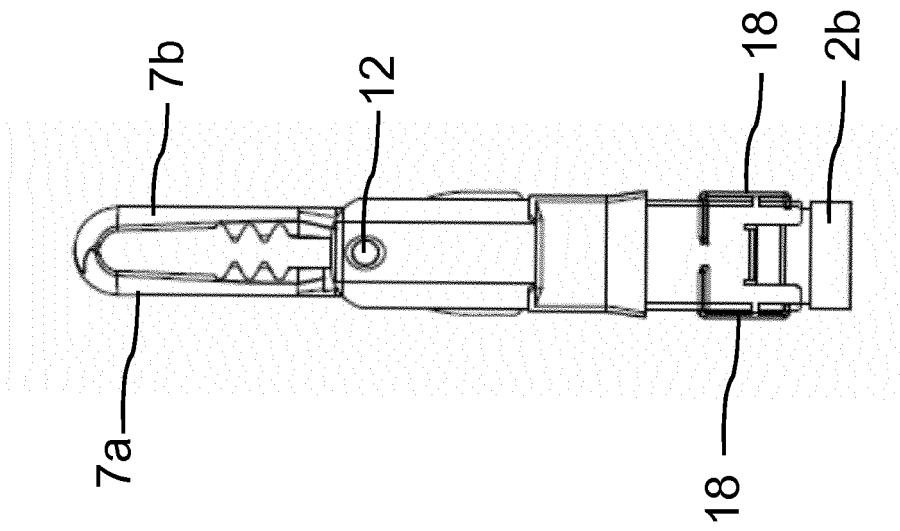


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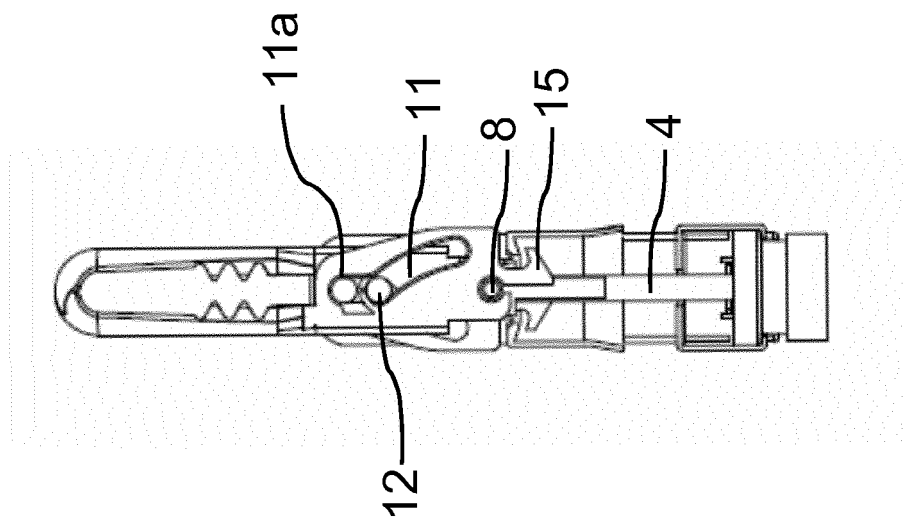


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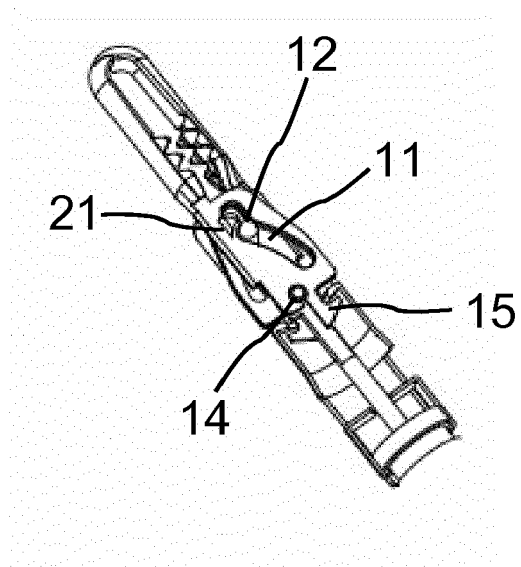


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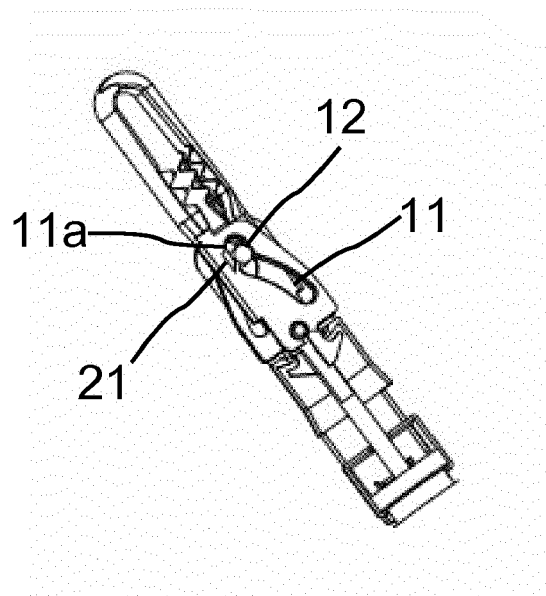


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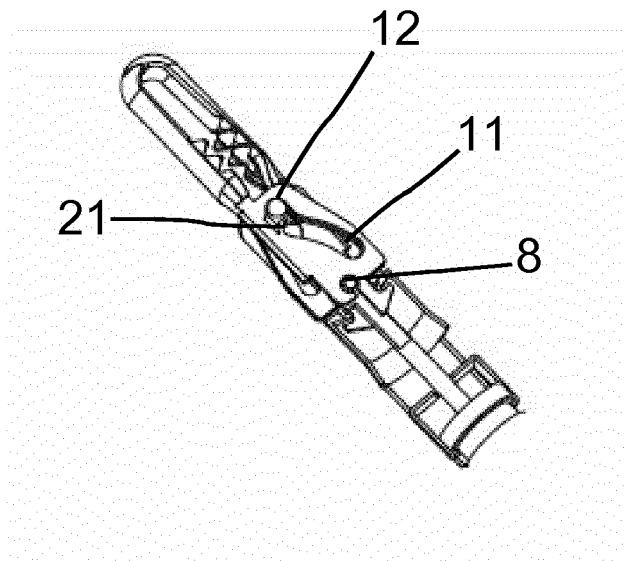


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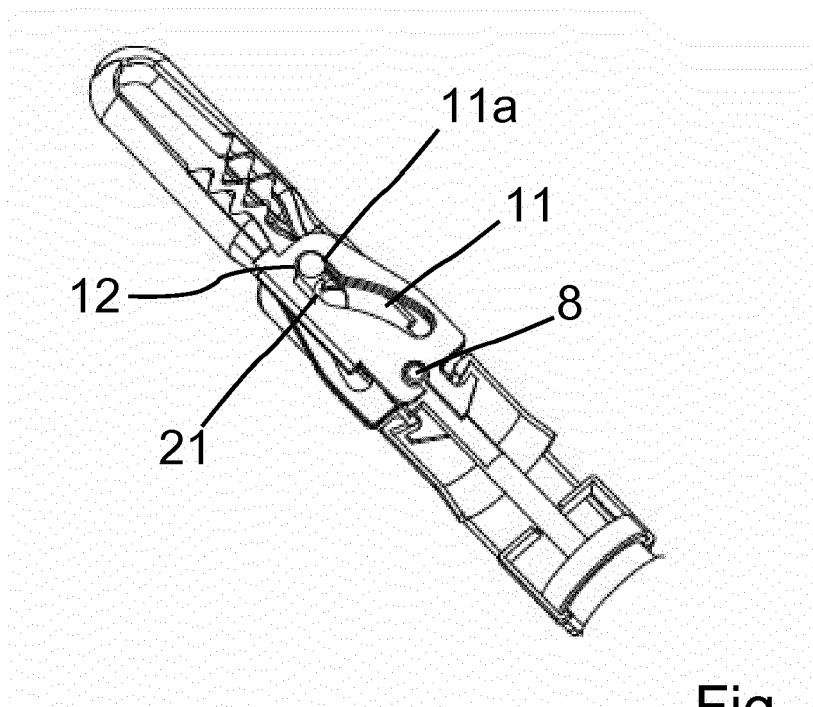


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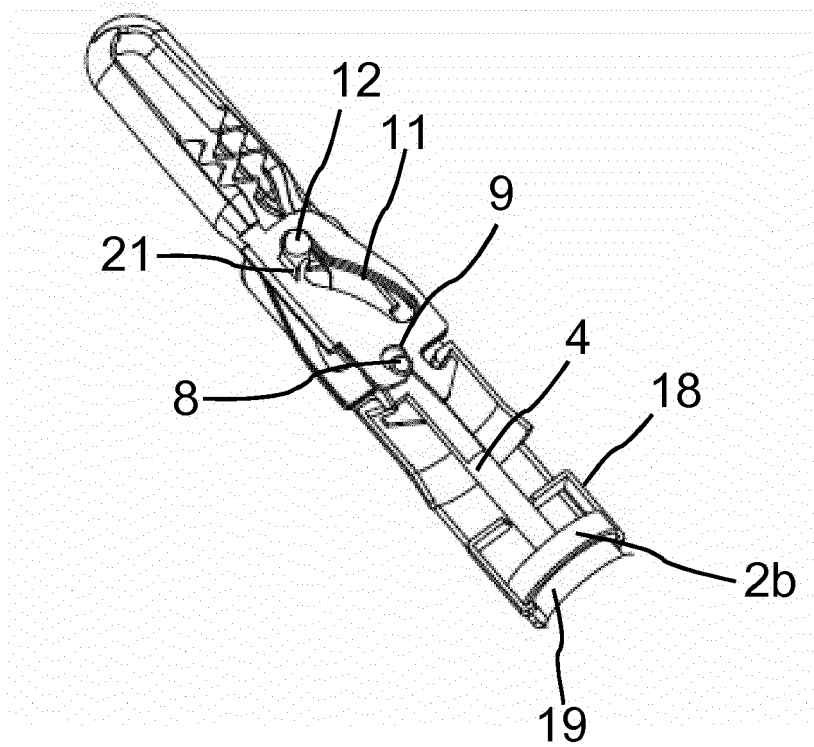


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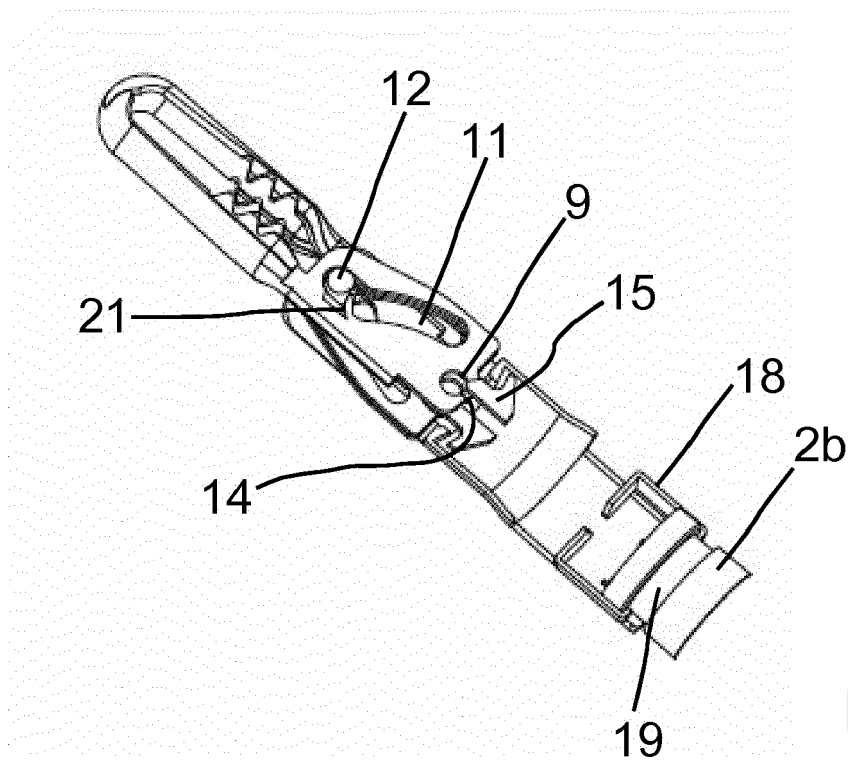


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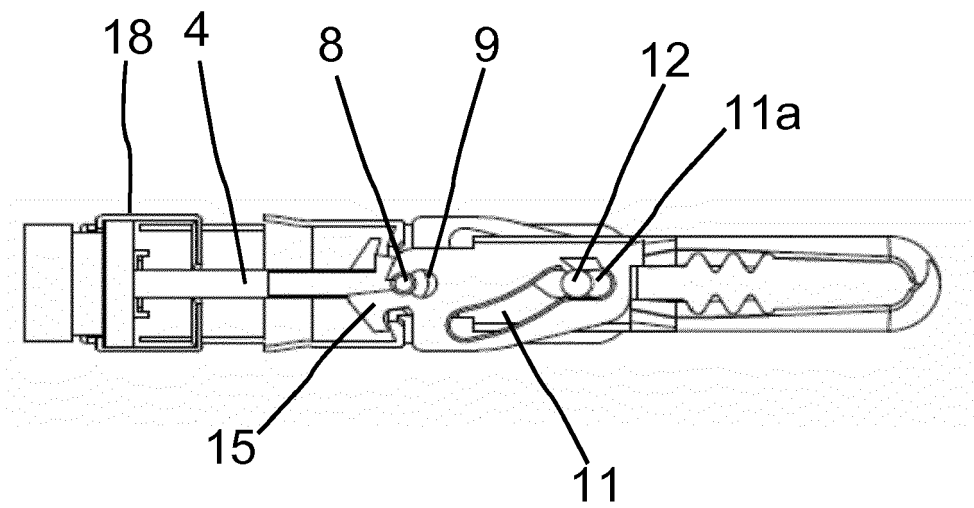


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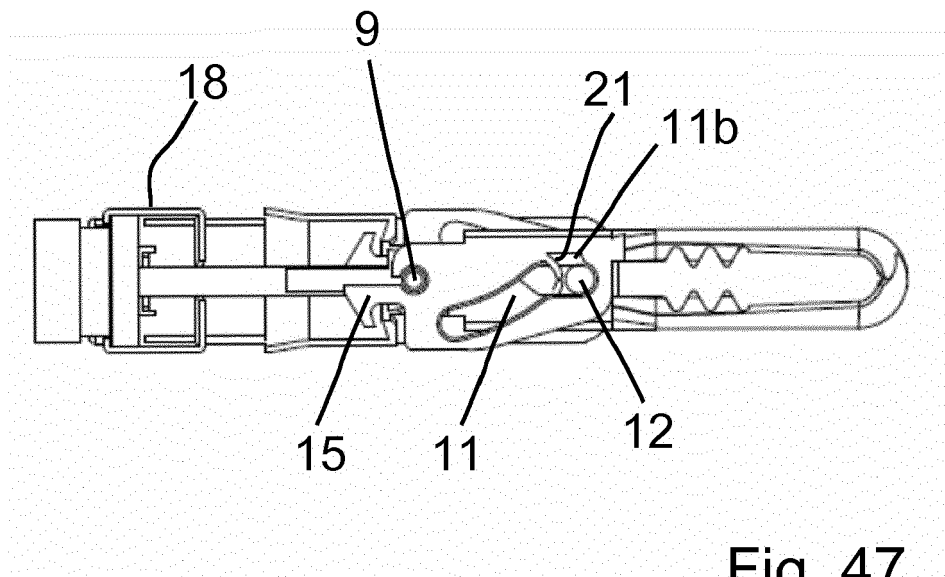


Fig. 47

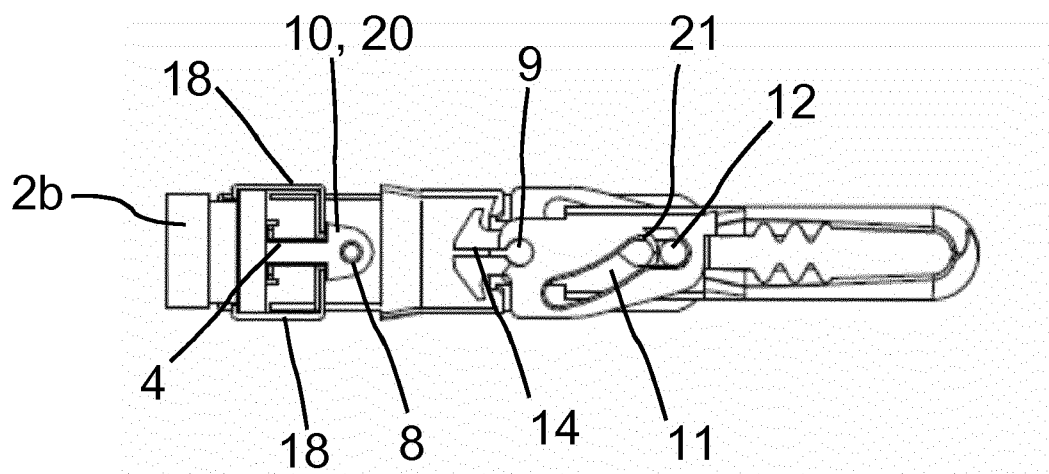


Fig. 48

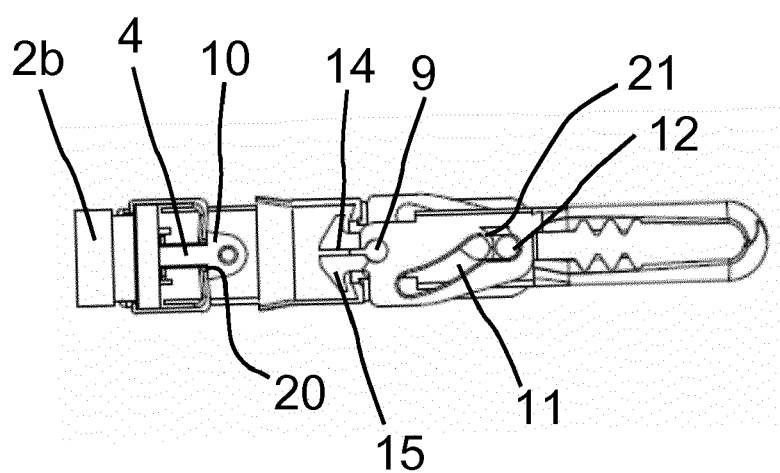


Fig. 49

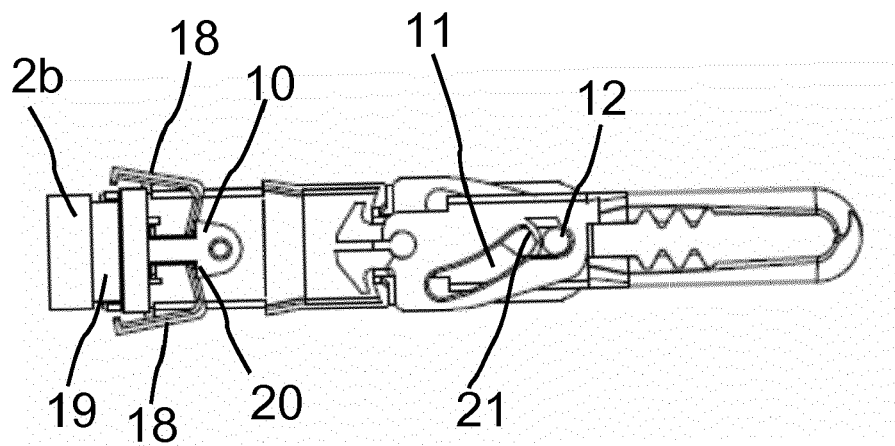


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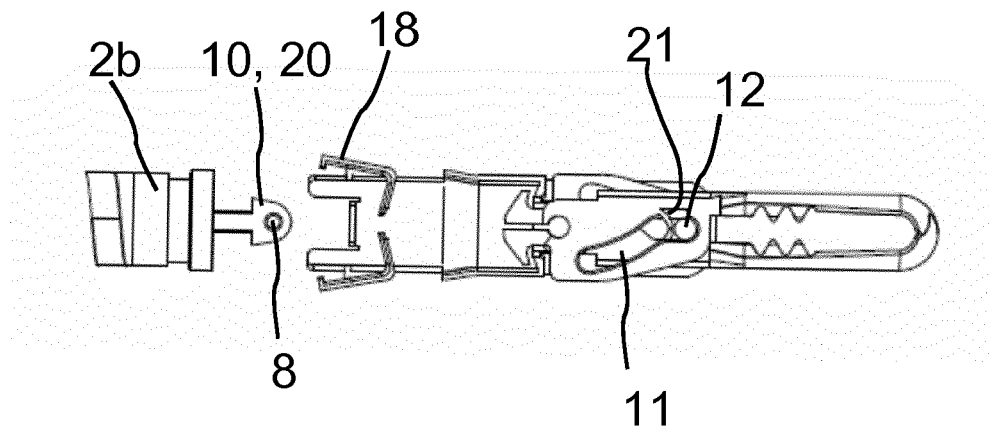


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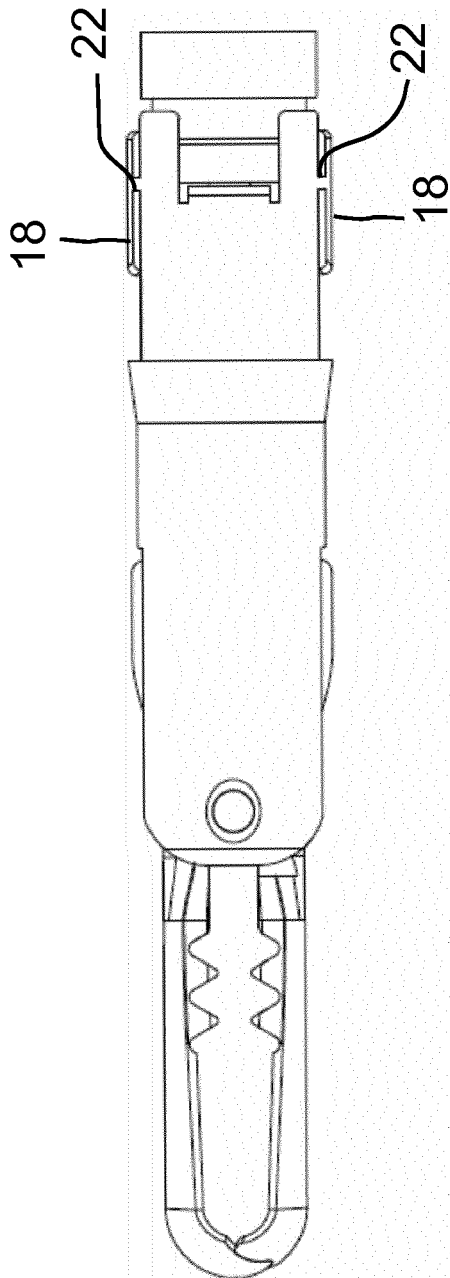


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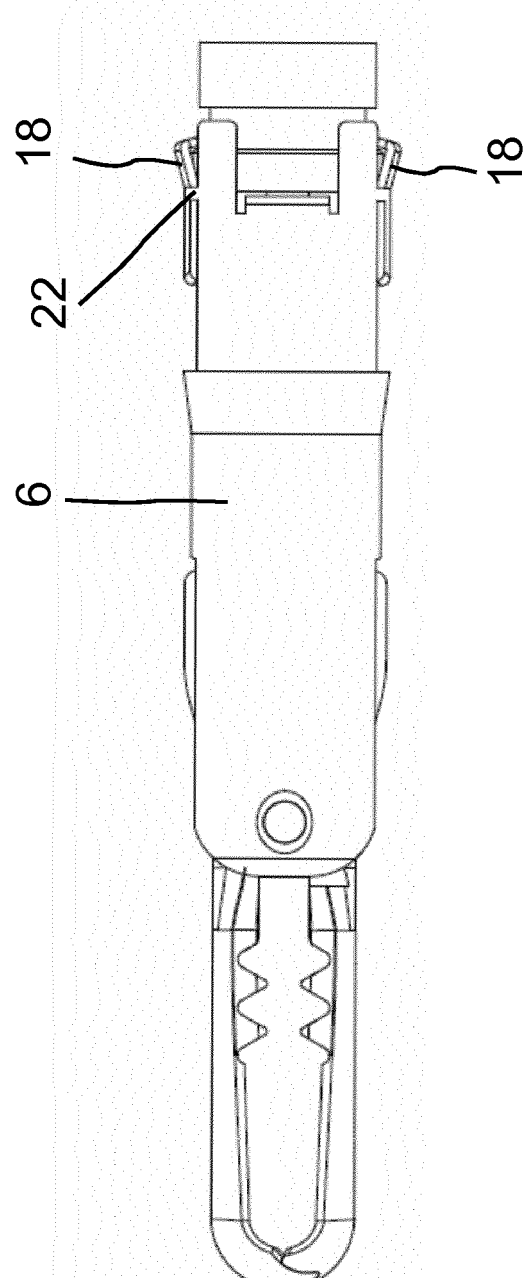


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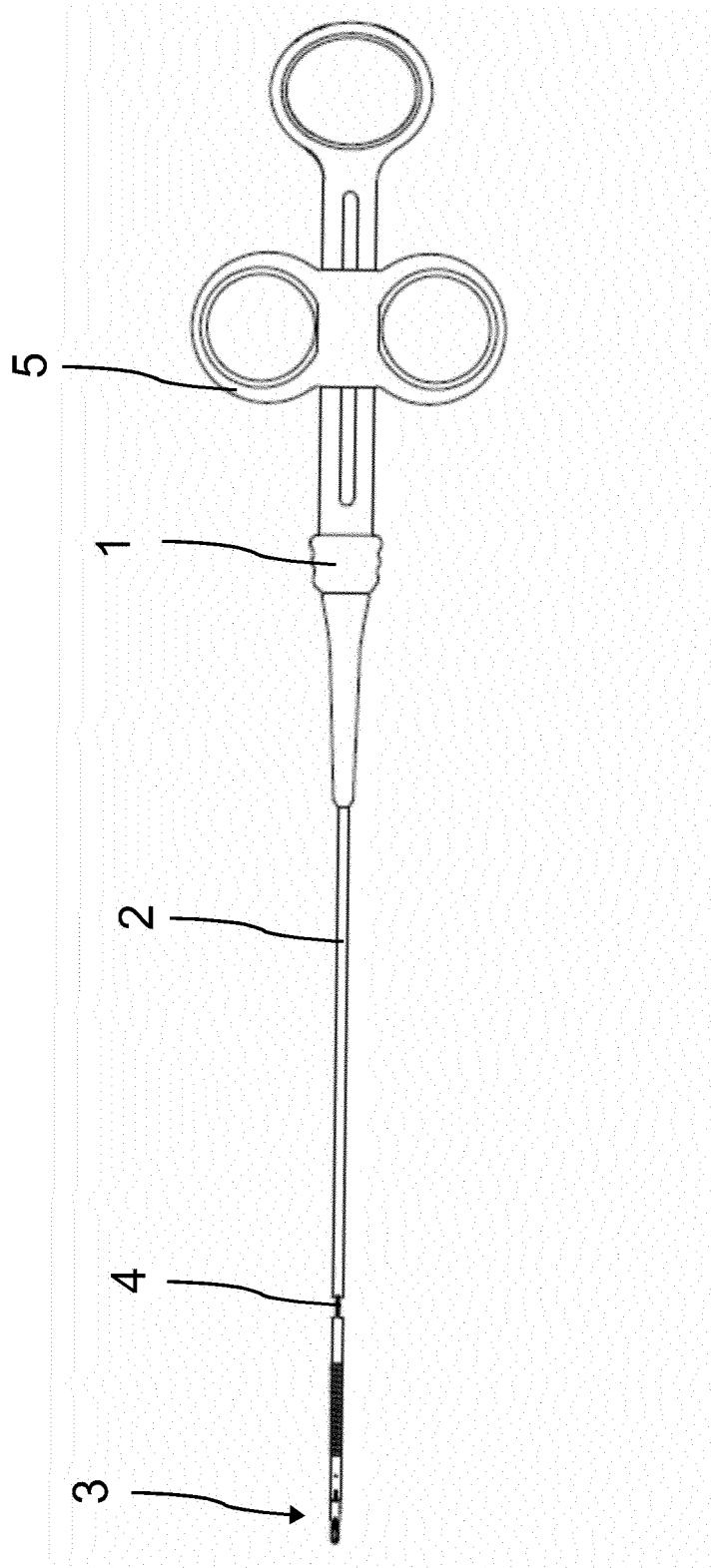


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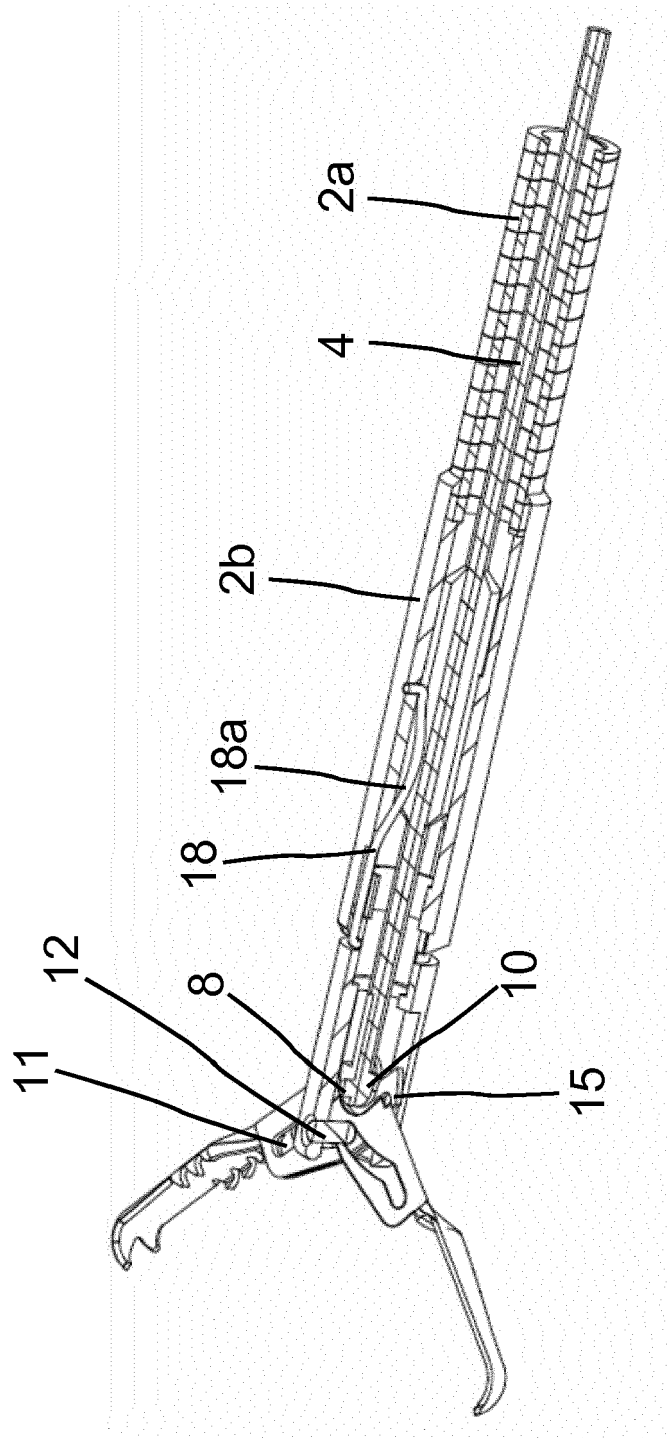


Fig. 55

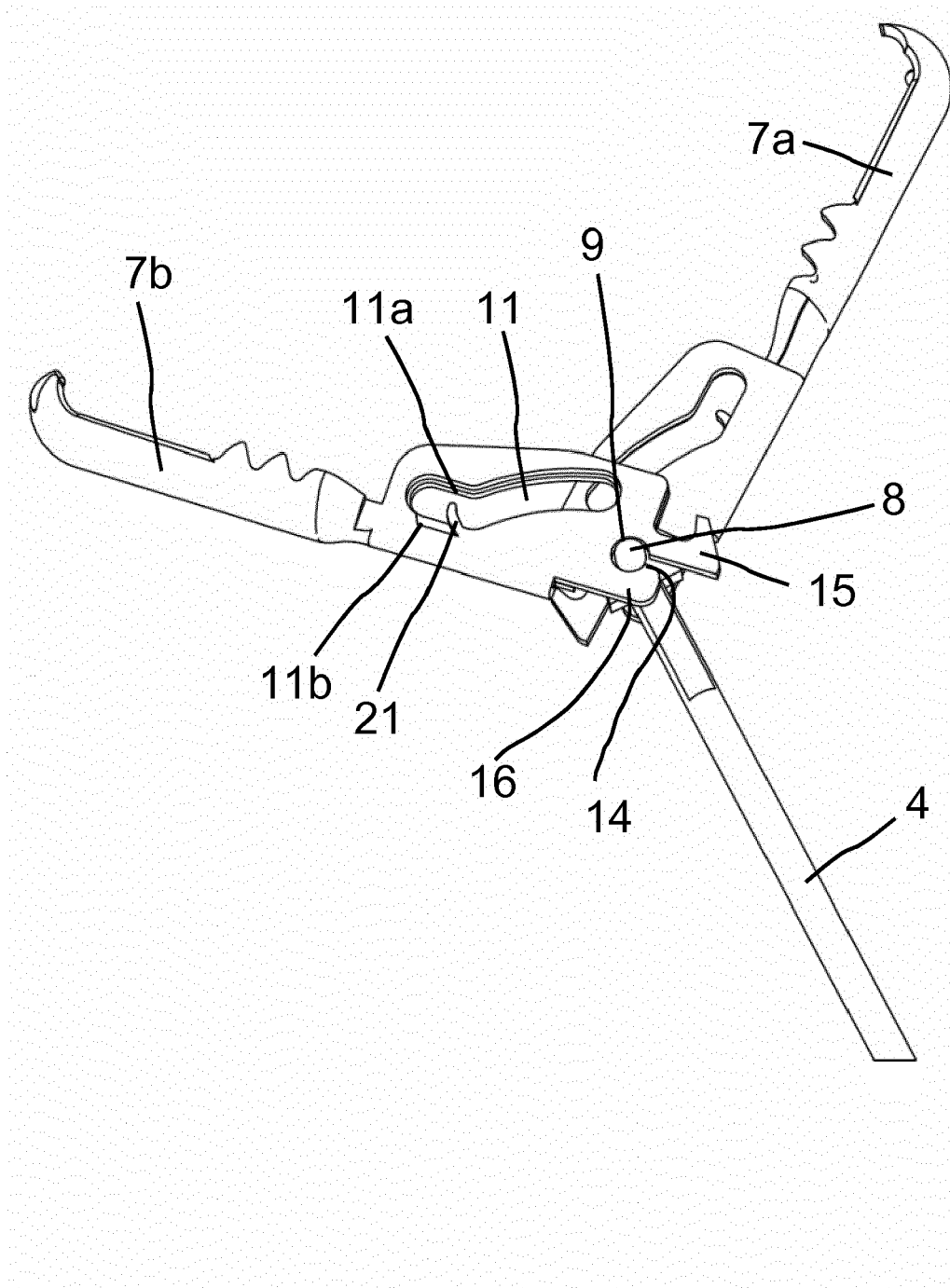


Fig. 56

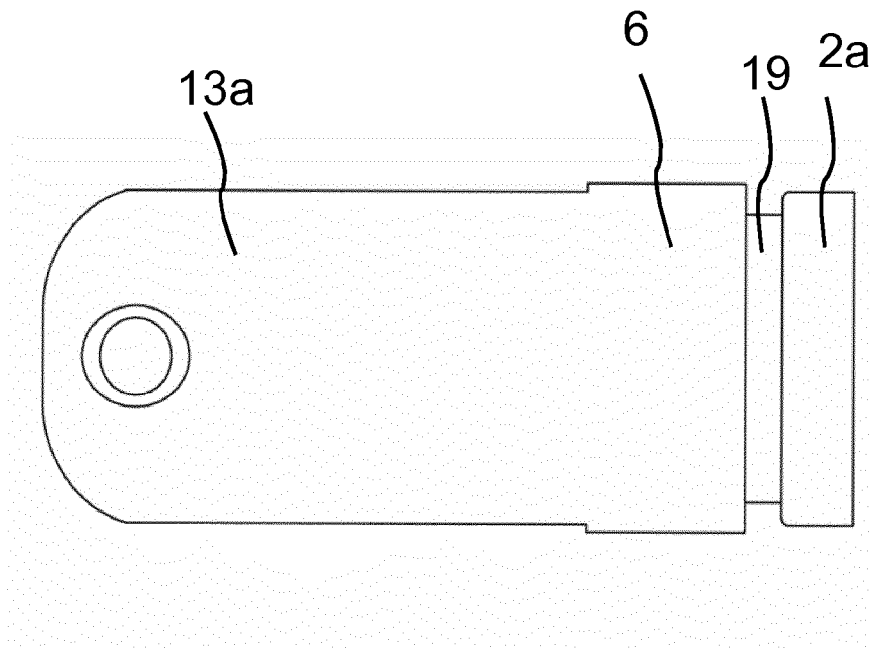


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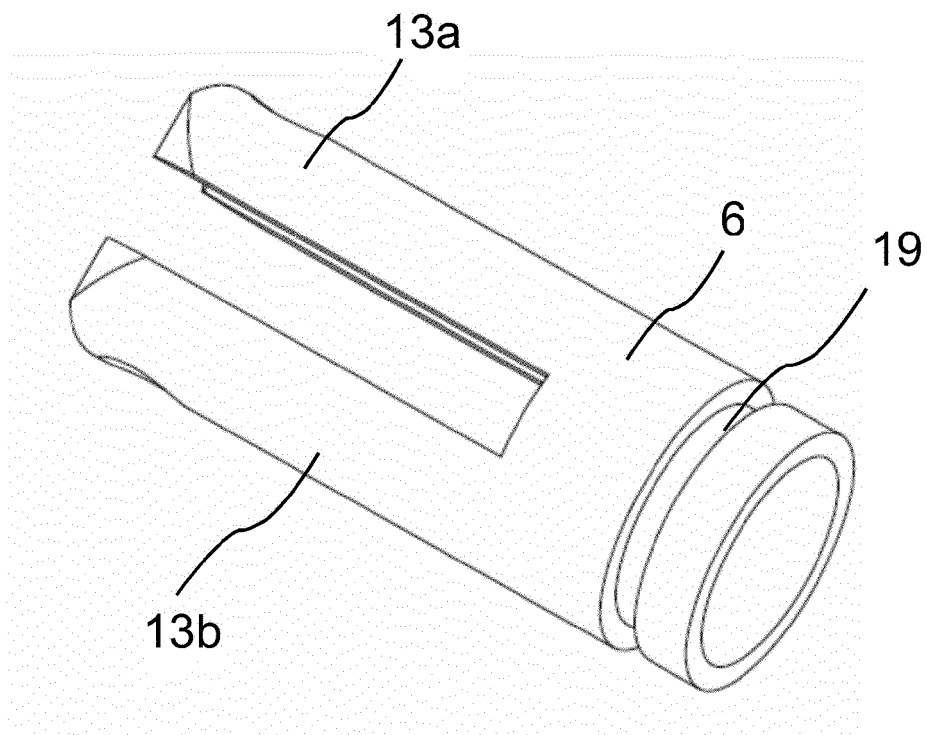


Fig. 58

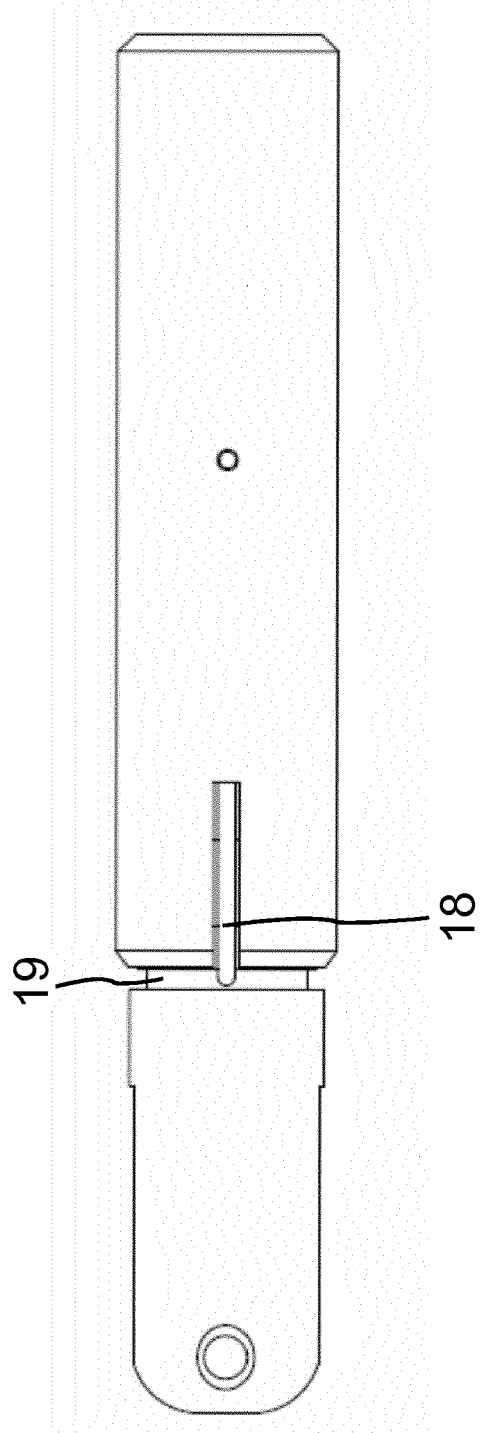


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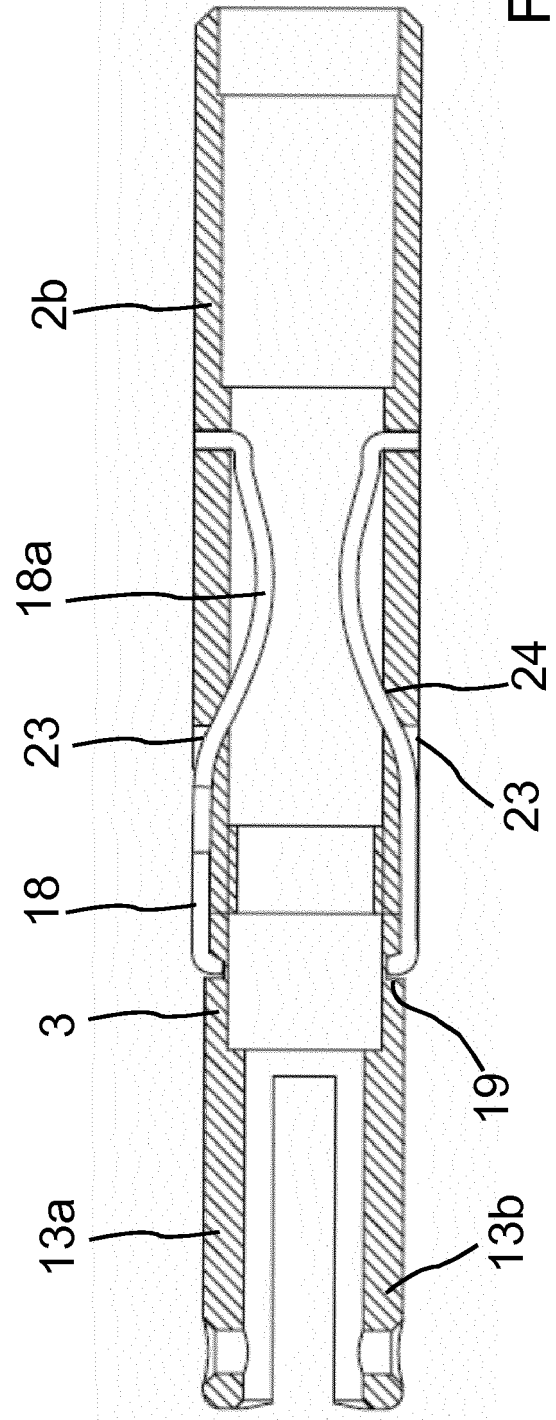


Fig. 60

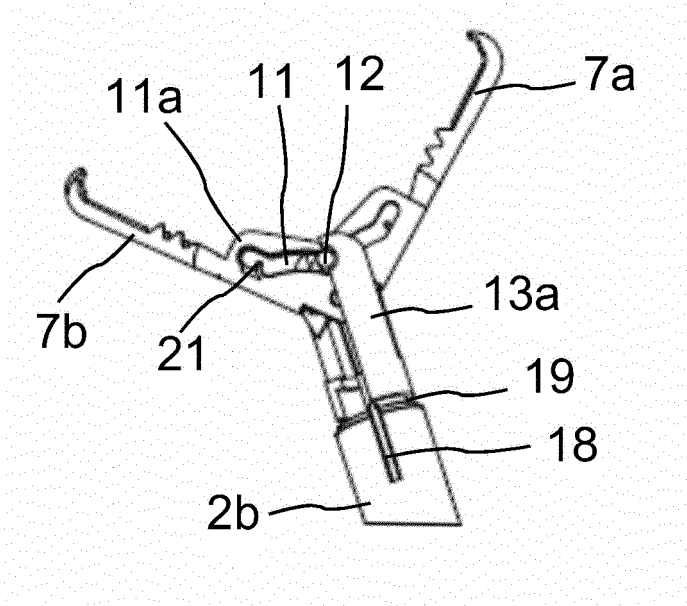


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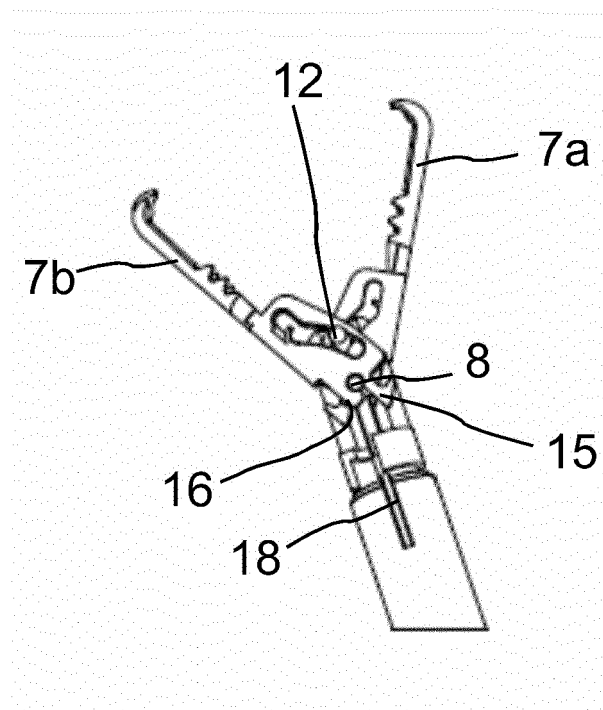


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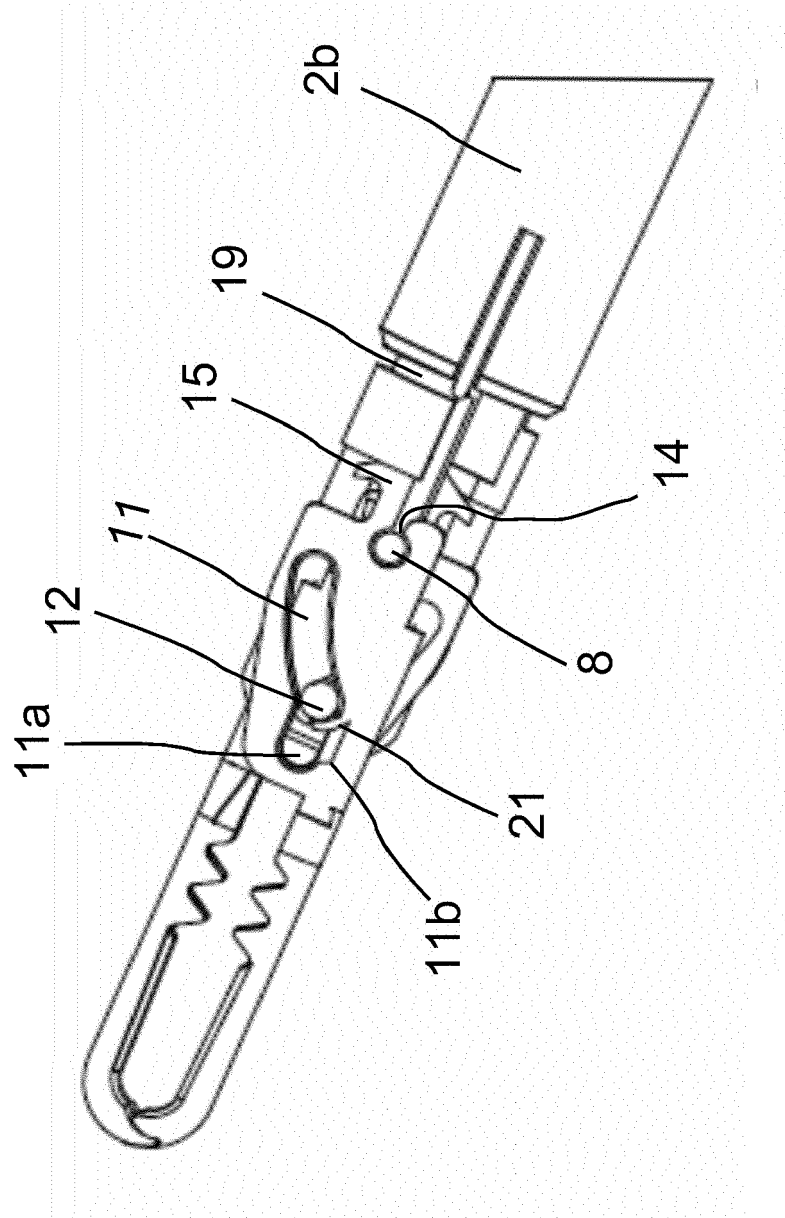


Fig. 63

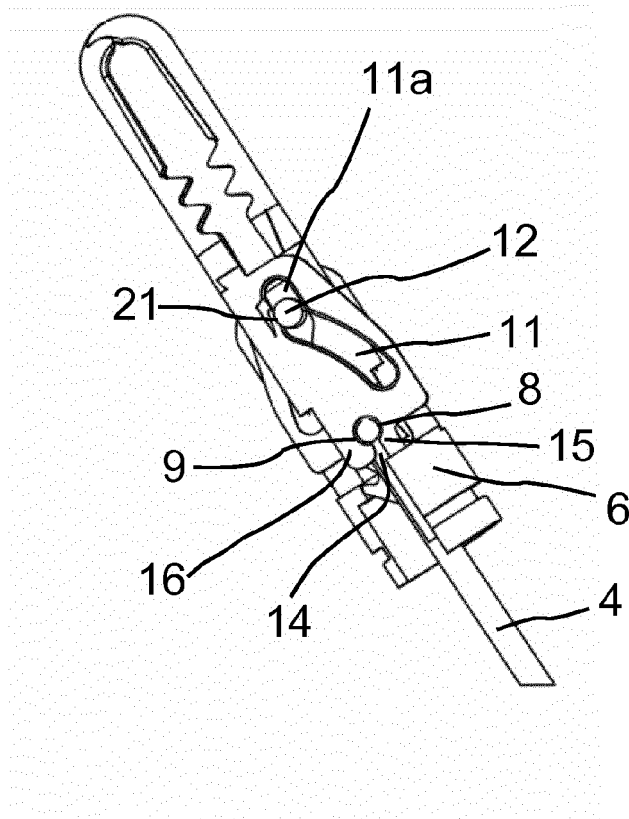


Fig. 64

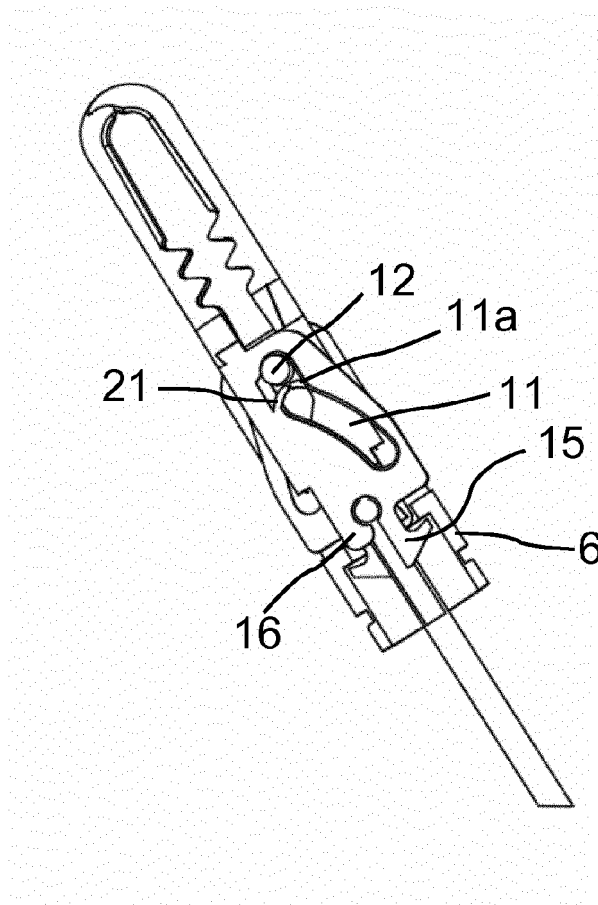


Fig. 65

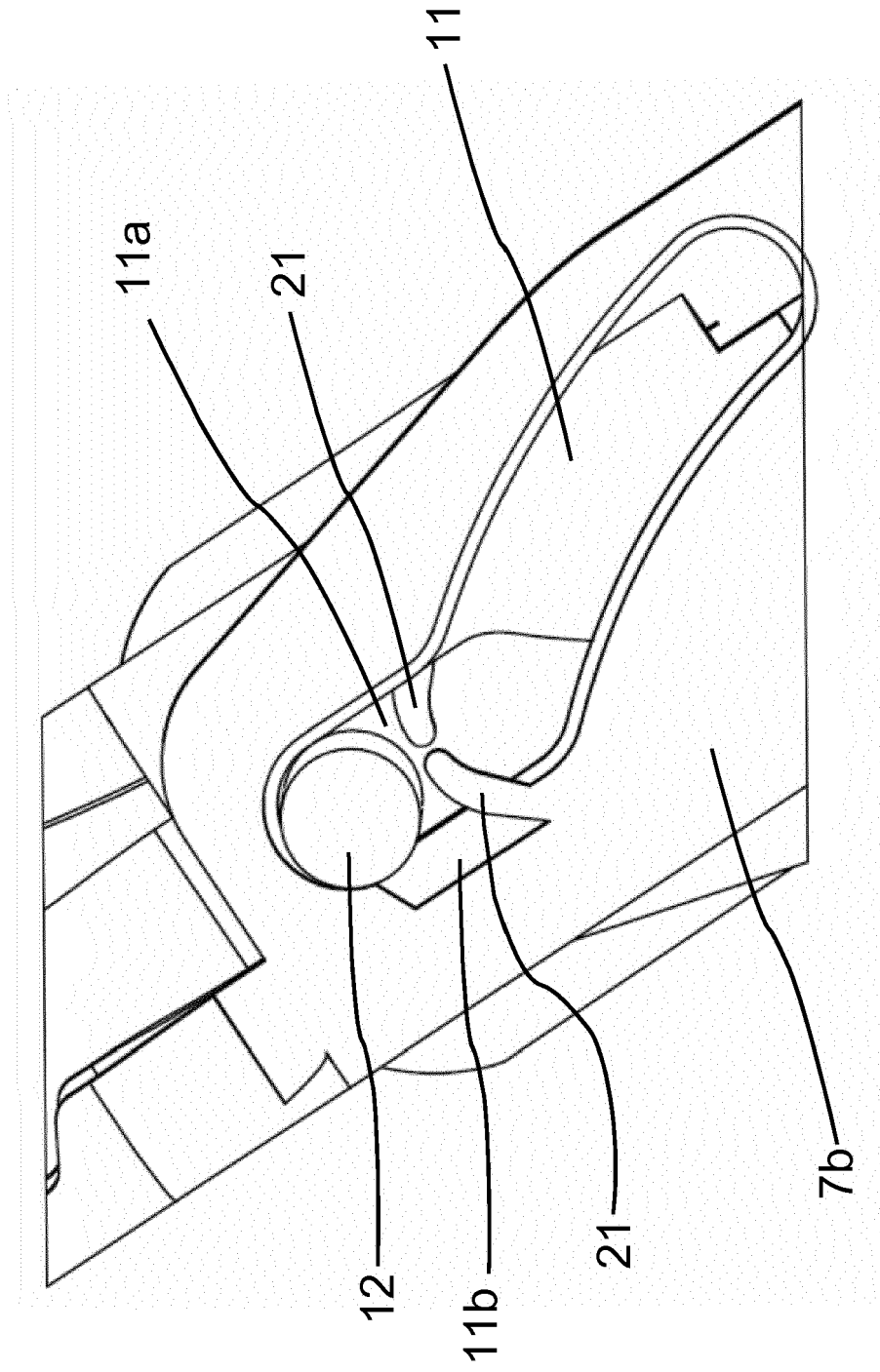


Fig. 66

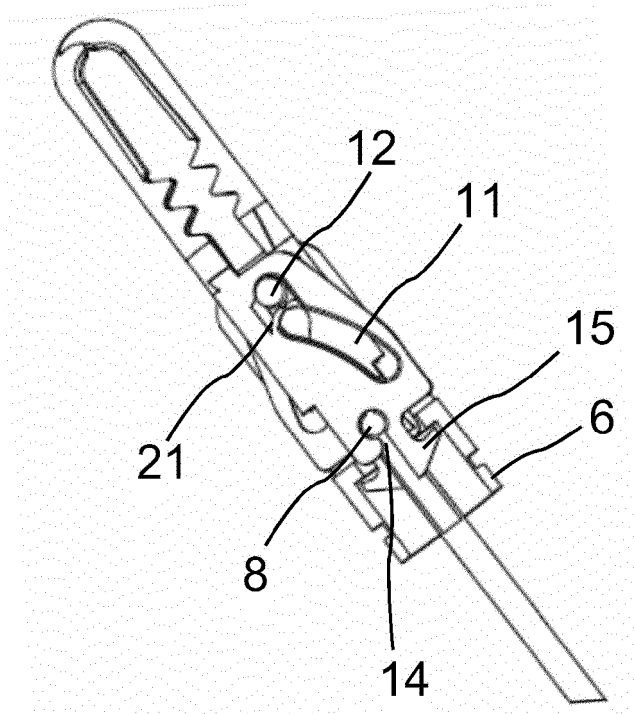


Fig. 67

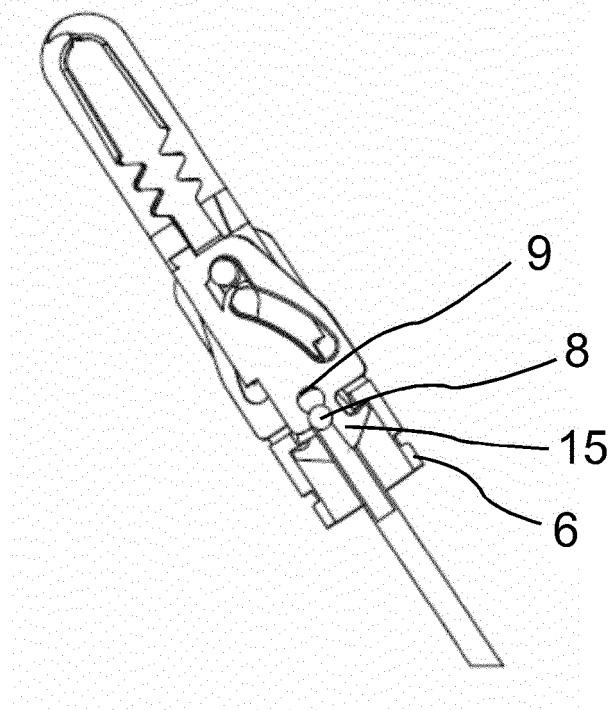


Fig. 68

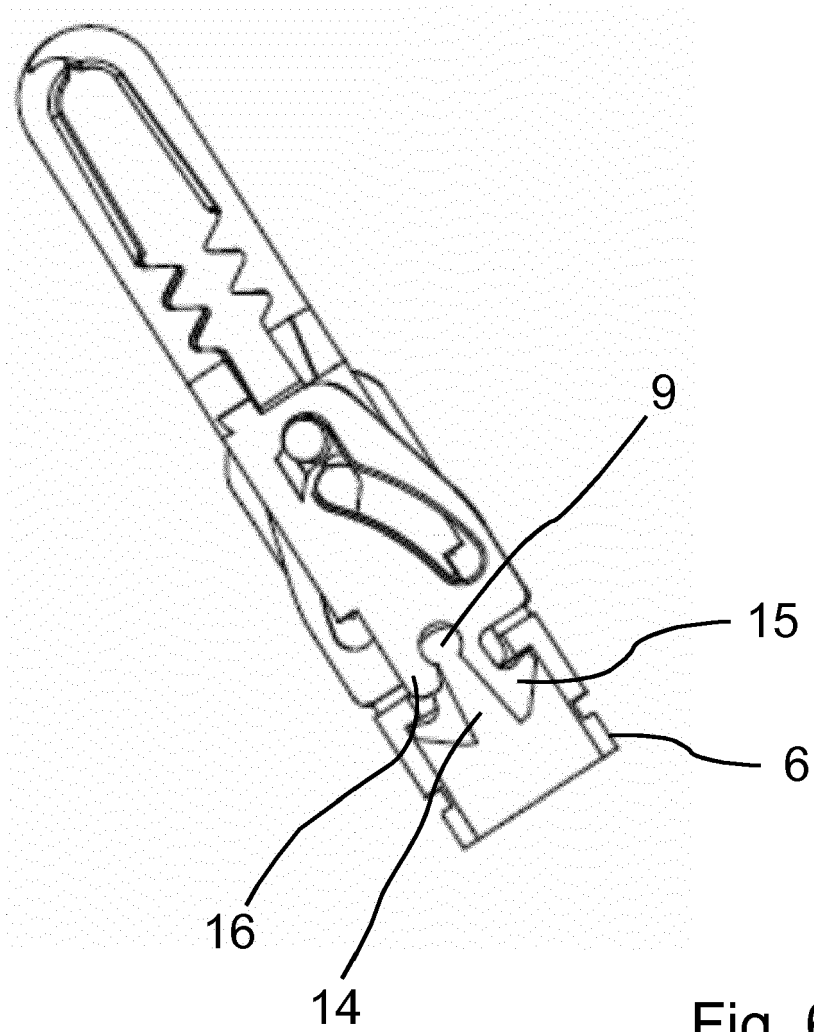


Fig. 69

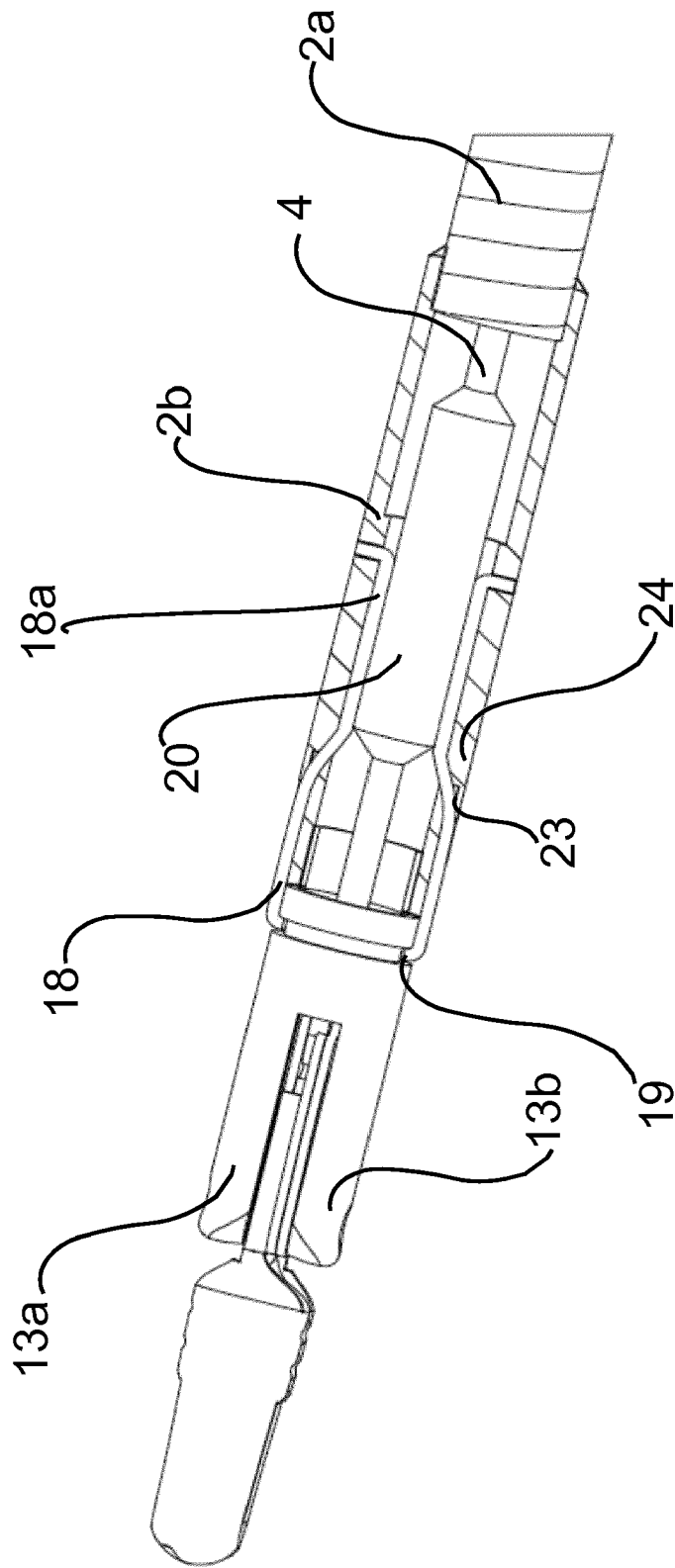


Fig. 70

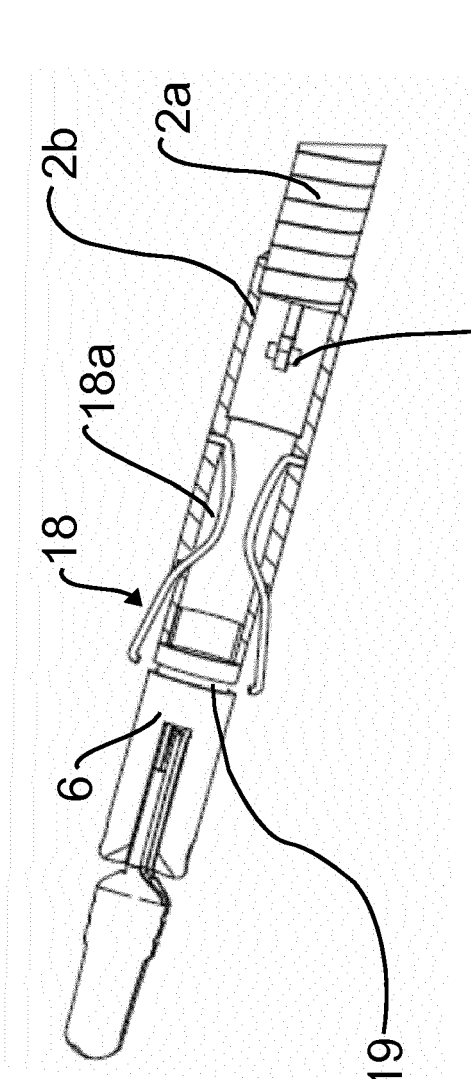


Fig. 71

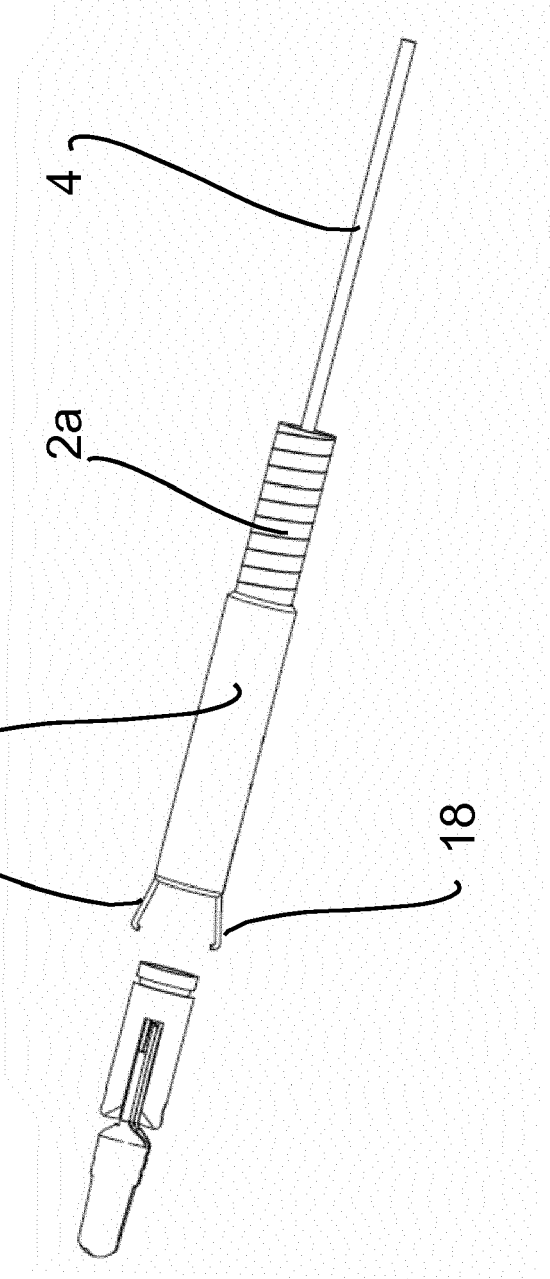


Fig. 72

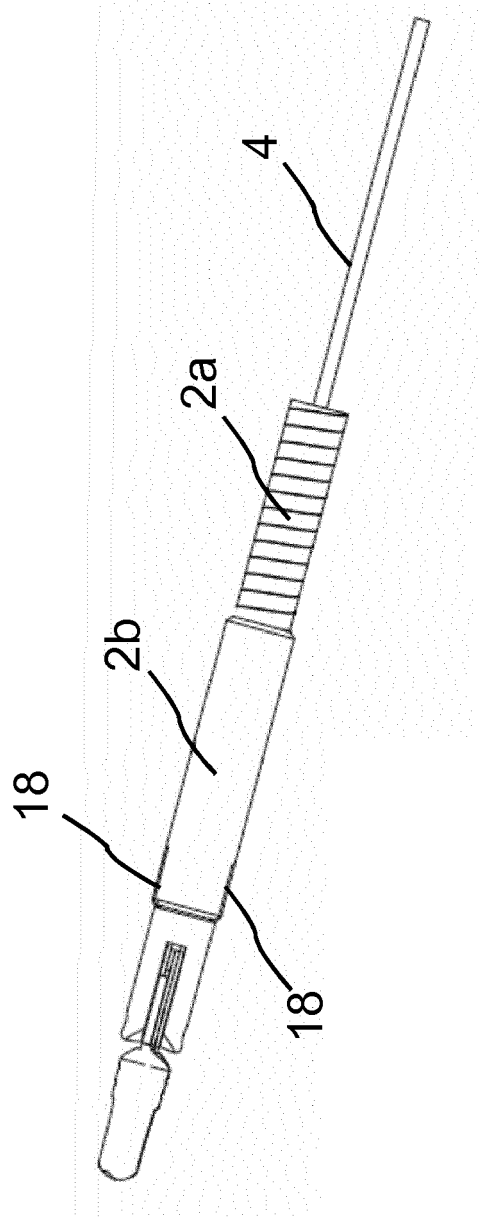


Fig. 73



EUROPEAN SEARCH REPORT

 Application Number
EP 19 16 9940

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 December 2019	Examiner Enborg, Andreas
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EUROPEAN SEARCH REPORT

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 December 2019	Examiner Enborg, Andreas
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

3
EPO FORM 1503 03.82 (P04C01)



Application Number

EP 19 16 9940

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



LACK OF UNITY OF INVENTION
SHEET B

Application Number

EP 19 16 9940

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-10

A medical device for causing hemostasis of a blood vessel, said device comprising: a handle, a sheath device attached to the handle, a clamp device including a clamp base and two clamp arms, a control wire and an actuator, wherein the clamp arms are actuatable to open and close by movement of the control wire in proximal and distal directions, the clamp arms being coupled to the distal end of the control wire by means of a pivot pin, further directed at the pivot pin extending through through-holes in the proximal end sections of the clamp arms and exit-passages are provided in the tail ends of the clamp arms so that the pivot pin can be pulled out of engagement with the clamp arms by spreading apart tail end sections of the clamp arms without breaking them.

2. claims: 11-14

A medical device for causing hemostasis of a blood vessel, said device comprising: a handle, a sheath device attached to the handle, a clamp device including a clamp base and two clamp arms, a control wire and an actuator, wherein the clamp arms are actuatable to open and close by movement of the control wire in proximal and distal directions, the clamp arms being coupled to the distal end of the control wire by means of a pivot pin, further directed at the clamp arms being provided with partially overlapping guide grooves and a guide pin attached to the clamp base and extending through the guide grooves so that the proximal movement of the control wire results in a closing movement of the clamp arms and distal movement of the control wire results in an opening movement of the clamp arms.

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 19 16 9940

5

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